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BOMBAY BRANCH

OF THE

Royal Asiatic Society.

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YEAR-BOOK

OF THE

87296

ROYAL SOCIETY OF LONDON.

1897-98.

LONDON:
HARRISON AND SONS, ST. MARTIN'S LANE,
Printers in Ordinary to Her Majesty
1898.

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HARRISON AND SONS,
PRINTERS IN ORDINARY TO HER MAJESTY,
ST. MARTIN'S LANE.

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YEAR-BOOK

OF

THE ROYAL SOCIETY.

1897–98.

MEETINGS OF THE SOCIETY.

1897.

NOVEMBER	18.	*Ordinary Meeting* at 4.30 P.M.
,,	25.	,, ,, ,,
,,	30.	*Anniversary Meeting* at 4 P.M.
DECEMBER	9.	*Ordinary Meeting* at 4.30 P.M.
,,	16.	,, ,, ,,

1898.

JANUARY	20.	*Ordinary Meeting* at 4.30 P.M.
,,	27.	,, ,, ,,
FEBRUARY	3.	,, ,, ,,
,,	10.	,, ,, ,,
,,	17.	,, ,, ,,
,,	24.	,, ,, ,,
MARCH	3.	,, ,, ,,
,,	10.	,, ,, ,,
,,	17.	,, ,, ,,
,,	24.	,, ,, ,,
APRIL	28.	,, ,, ,,
MAY	5.	,, ,, ,,
,,	12.	,, ,, ,,
,,	26.	,, ,, ,,
JUNE	9.	*Election of Fellows* at 4 P.M.
,,	9.	*Ordinary Meeting* at 4.30 P.M.
,,	16.	,, ,, ,,
NOVEMBER	17.	*Ordinary Meeting* at 4.30 P.M.
,,	24.	,, ,, ,,
,,	30.	*Anniversary Meeting* at 4 P.M.
DECEMBER	8.	*Ordinary Meeting* at 4.30 P.M.
,,	15.	,, ,, ,,

Certificates of candidates for the Fellowship must be received before the first meeting in March.

Applications to be considered by the Government Grant Committee must be received by January 31, and Reports on Grants must be furnished by that date.

THE LIST OF THE ROYAL SOCIETY, Nov. 30, 1897.

HER SACRED MAJESTY QUEEN VICTORIA, PATRON.

Date of Election.	
1863. Feb. 12.	HIS ROYAL HIGHNESS THE PRINCE OF WALES, K.G.
1882. Mar. 16.	HIS ROYAL HIGHNESS THE DUKE OF SAXE-COBURG AND GOTHA, K.G.
1893. June 8.	HIS ROYAL HIGHNESS THE DUKE OF YORK, K.G.

THE COUNCIL.

THE LORD LISTER, F.R.C.S., D.C.L.—PRESIDENT.
SIR JOHN EVANS, K.C.B., D.C.L., LL.D.—TREASURER and VICE-PRESIDENT.
PROF. MICHAEL FOSTER, M.A., M.D., D.C.L., LL.D.—SECRETARY.
PROF. ARTHUR WILLIAM RÜCKER, M.A., D.Sc.—SECRETARY.
SIR EDWARD FRANKLAND, K.C.B., D.C.L., LL.D.—FOREIGN SECRETARY.

PROF. WILLIAM GRYLLS ADAMS, M.A.
PROF. THOMAS CLIFFORD ALLBUTT, M.D.
SIR ROBERT STAWELL BALL, M.A.
REV. PROF. THOMAS GEORGE BONNEY, D.Sc.
PROF. JOHN CLELAND, M.D.
PROF. ROBERT BELLAMY CLIFTON, M.A.—VICE-PRESIDENT.
PROF. JAMES ALFRED EWING, M.A.
ALFRED BRAY KEMPE, M.A.
JOHN NEWPORT LANGLEY, D.Sc.
JOSEPH LARMOR, D.Sc.
PROF. NEVIL STORY MASKELYNE, M.A.—VICE-PRESIDENT.
PROF. RAPHAEL MELDOLA, F.C.S.
PROF. EDWARD BAGNALL POULTON, M.A.
WILLIAM JAMES RUSSELL, Ph.D.—VICE-PRESIDENT.
DUKINFIELD HENRY SCOTT, M.A.
PROF. WALTER FRANK RAPHAEL WELDON, M.A.

*** *This Council will continue till November* 30, 1898.

Assistant-Secretary and Librarian.
ROBERT W. F. HARRISON.

Clerk.
THEODORE E. JAMES.

Assistant Librarian.
A. HASTINGS WHITE.

Office Assistant.
RICHARD CHAPMAN.

FELLOWS OF THE SOCIETY.

(C) prefixed to a name indicates the award of the Copley Medal.
(R) ,, ,, ,, ,, ,, Royal Medal.
(Rm) ,, ,, ,, ,, ,, Rumford Medal.
(D) ,, ,, ,, ,, ,, Davy Medal.
(DW) ,, ,, ,, ,, ,, Darwin Medal.
(B) ,, ,, ,, ,, ,, Buchanan Medal.

Date of Election.	Served on Council.	Held Office.	Medals.	
June 7, 1860.	'67–69 '77–79	V.P. '77–78	R.	Abel, Sir Frederick Augustus, Bart., K.C.B., D.C.L. (Oxon.), D.Sc. (Camb.). 2, *Whitehall-court*, S.W. *and Imperial Institute, Imperial Institute-road*, S.W.
June 1, 1876.	'83–85 '91–93		Rm.	Abney, William de Wiveleslie, Capt. R.E., C.B., D.C.L. (Dunelm.), Director for Science in the Science and Art Department. *Rathmore Lodge, Bolton-gardens South, Earl's Court*, S.W.; *and Athenæum Club*, S.W.
Jan. 21, 1847.	'58–59			Acland, Sir Henry Wentworth Dyke, Bart., K.C.B., M.D., LL.D. (Cantab.), Radcliffe Librarian and late Reg. Prof. of Medicine in the University of Oxford. *Broad-street, Oxford.*
June 6, 1872.	'82–84 '96–97			Adams, William Grylls, M.A., D.Sc., Professor of Natural Philosophy and Astronomy in King's College, London. 43, *Camden-hill-square*, W.
June 7, 1883.				Aitchison, James Edw. Tierney, C.I.E., M.D., LL.D. (Edin.), Brigade Surgeon H.M. Bengal Army (retired). *Leyden House, Mortlake*, S.W.
June 6, 1889.				Aitken, John, F.R.S.E. *Ardenlea, Falkirk.*
June 3, 1880.	'96–97			Allbutt, Thomas Clifford, M.A., M.D., Regius Professor of Physic in the University of Cambridge. *St. Radegund's, Cambridge.*
June 1, 1854.	'71–73		R.	Allman, George James, M.D., LL.D., Emeritus Regius Professor of Natural History in the University of Edinburgh. *Ardmore, Parkstone, Poole, Dorsetshire; and Athenæum Club*, S.W.
June 12, 1884.				Allman, George Johnston, LL.D. (Dubl.), D.Sc., Emeritus Professor of Mathematics in Queen's College, Galway. *St. Mary's, Galway.*
June 12, 1879.				Anderson, John, M.D., LL.D. (Edin.), late Superintendent, Indian Museum, and Professor of Comparative Anatomy in the Medical College, Calcutta. 71, *Harrington-gardens*, S.W.
June 4, 1891.				Anderson, Sir William, K.C.B., D.C.L., Director-

Date of Election.	Served on Council.	Held Office.	Medals.	
				General of Royal Ordnance Factories. *Lesney House, Erith; and Royal Arsenal, Woolwich.*
June 7, 1888.				Andrews, Thomas, Mem. Inst. C.E. *Ravencrag, Wortley, near Sheffield.*
June 19, 1851.	'55–56 '83–84	V.P. '83–84		Argyll, George Douglas Campbell, Duke of, K.G., K.T., D.C.L. (Oxon.), LL.D. (Camb.). *Argyll Lodge, Kensington, W.; and Inverary Castle, Argyleshire.*
June 12, 1873.				Armstrong, Sir Alexander, K.C.B., M.D., LL.D. (Dubl.), late Director-General of the Medical Department of the Navy. *The Elms, Sutton Bonnington, Loughborough, Leicestershire.*
June 1, 1876.	'88–90			Armstrong, Henry Edward, Ph.D. (Lips.), LL.D. (St. Andr.), Professor of Chemistry at the City and Guilds of London Central Institute. 55, *Granville-park, Lewisham,* S.E.; *and Athenæum Club,* S.W.
May 7, 1846.	'61–62			Armstrong, William George, Lord, C.B., D.C.L. (Oxon.), LL.D. (Cantab.). *Athenæum Club; Cragside, Rothbury; and Newcastle-upon-Tyne.*
June 3, 1880.				Attfield, John, M.A., Ph.D. (Tüb.), Late Professor of Practical Chemistry to the Pharmaceutical Society of Great Britain. *Ashlands, Watford; and* 11, *Temple Chambers,* E.C.
June 2, 1881.	'89–91			Ayrton, William Edward, Professor of Applied Physics in the Central Technical College of the City and Guilds of London Institute. *Exhibition-road,* S.W.
June 4, 1885.				Baird, Andrew Wilson, Colonel, R.E., C.S.I. *Care of Messrs. Grindlay, Groom & Co., Bombay, India.*
June 5, 1890.	'92–93			Baker, Sir Benjamin, K.C.M.G., LL.D. 2, *Queen-square-place, Queen Anne's Mansions, Westminster; and Athenæum Club,* S.W.
June 6, 1878.	'83–84			Baker, John Gilbert, F.L.S. Keeper of the Herbarium, Royal Gardens, Kew. *Royal Herbarium, Kew.*
Jan. 12, 1888.				Balfour, Right. Hon. Arthur James, D.C.L. 10, *Downing-street,* S.W.; *and Whittinghame, Prestonkirk,* N.B.
June 12, 1884.	'92–94			Balfour, Isaac Bayley, D.Sc., M.D. (Edin.), Keeper of the Royal Botanic Garden, Edinburgh, Queen's Botanist in Scotland, and Professor of Botany in the University of Edinburgh. *Inverleith House, Edinburgh; and Athenæum Club,* S.W.
June 12, 1873.				Ball, Sir Robert Stawell, Kt., Hon., M.A. (Cantab.), LL.D., Pres.R.A.S., Lowndean Professor of Astro-

Date of Election.	Served on Council.	Held Office.	Medals.	
				nomy and Geometry in the University of Cambridge. *The Observatory, Cambridge; and Athenæum Club*, S.W.
June 2, 1864.				Barkly, Sir Henry, G.C.M.G., K.C.B. 1, *Binagardens, South Kensington*, S.W.
June 6, 1850.	'80-81	V.P. '80-81		Barlow, William Henry, F.R.S.E. *High Combe, Old Charlton, Kent.*
Dec. 12, 1844.				Barrow, John, F.S.A., F.R.G.S. 17, *Hanover-terrace, Regent's Park*, N.W.
June 13, 1895.				Barry, Sir John Wolfe, K.C.B., Pres. Inst. C.E. 23, *Delahay-street, Westminster*, S.W.
June 6, 1889.				Basset, Alfred Barnard, M.A. *Fledborough Hall, Holyport, Berks.*
June 4, 1868.				Bastian, Henry Charlton, M.A., M.D., Professor of the Principles and Practice of Medicine, University College, Physician to University College Hospital. 8A, *Manchester-square*, W.
June 7, 1894.				Bateson, William, M.A., *Norwich House, Cambridge.*
June 11, 1857.	'65–67			Beale, Lionel Smith, M.B., Prof. of the Principles and Practice of Medicine in King's College, London, and Government Medical Referee for England. 61, *Grosvenor-street*, W.
June 2, 1892.				Beddard, Frank Evers, M.A. (Oxon.), Lecturer on Comparative Anatomy, Guy's Hospital, Prosector to the Zoological Society. *Zoological Society's Gardens, Regent's Park*, N.W.
June 12, 1873.				Beddoe, John, M.D., LL.D. (Edin.). *The Chantry, Bradford-on-Avon; and Athenæum Club*, S.W.
June 4, 1874.	'81–82			Bell, Sir Lowthian, Bart., Mem. Inst. C.E. *Rounton Grange, by Northallerton.*
June 12, 1884.				Bell, James, C.B., D.Sc. (Dubl.), late Principal of the Inland Revenue Laboratory, Somerset House. *Howell Hill Lodge, Ewell, Surrey.*
June 3, 1897.				Bell, Robert, M.D., B.A.Sc., LL.D., Assistant Director of the Geological Survey of Canada. *Sussex-street, Ottawa, Canada.*
June 8, 1871.				Besant, William Henry, D.Sc., Fellow of St. John's College, Cambridge. *St. John's College, and Spring Lawn, Harvey-road, Cambridge.*
June 12, 1879.				Bessemer, Sir Henry, Hon. Mem. Inst. C.E. *Denmark-hill*, S.E.
June 4, 1886.				Bidwell, Shelford, M.A., LL.B. *Riverstone Lodge, Southfields, Wandsworth*, S.W.
April 6, 1843.				Blake, Henry Wollaston, M.A. 8, *Devonshire-place, Portland-place*, W.
June 4, 1874.	'91–93	V.P. '92–93		Blanford, William Thomas, LL.D. (Univ. McGill). 72, *Bedford-gardens, Campden-hill, Kensington, W.*

Date of Election.	Served on Council.	Held Office.	Medals.	
June 6, 1878.	'80–82 '95			Bonney, Rev. Thomas George, D.Sc., LL.D. (Univ. McGill), Professor of Geology in University College, London. 23, *Denning-road, Hampstead*, N.W.
June 5, 1890.				Bosanquet, Robert Holford Macdowall, M.A., Fellow of St. John's College, Oxford. *Castillo Zamora, Realejo-Alto, Teneriffe.*
June 7, 1888.				Bottomley, James Thomson, M.A., D.Sc., Lecturer on Natural Philosophy in the University of Glasgow. 13, *University-gardens, Glasgow.*
June 7, 1894.				Boulenger, George Albert, F.Z.S., 8, *Courtfield-road, South Kensington*, S.W.
June 13, 1895.				Bourne, Alfred Gibbs, D.Sc., Professor of Biology in the Presidency College, Madras. *Presidency College, Madras.*
June 4, 1891.				Bower, Frederick Orpen, D.Sc. (Camb.), Regius Professor of Botany in the University of Glasgow. 45, *Kersland-terrace, Hillhead, Glasgow.*
June 3, 1858.				Boxer, Edward Mounier, Major-General, R.A. *Upton, near Ryde.*
June 7, 1888.			R.	Boys, Charles Vernon, A.R.M.S. 27, *The Grove, Bolton*, S.W.
June 7, 1894.				Bradford, John Rose, M.D., D.Sc., Assistant Professor of Clinical Medicine, University College, London. 60, *Wimpole-street, Cavendish-square, W.*
June 8, 1882.				Brady, George Stewardson, M.D., LL.D., Professor of Natural History in the Durham College of Science, Newcastle. 2, *Mowbray-villas, Sunderland.*
June 12, 1873.	'77–78			Bramwell, Sir Frederick Joseph, Bart., D.C.L., LL.D., M. Inst. C.E. 5, *Great George-street, Westminster*, S.W.
June 3, 1875.				Brandis, Sir Dietrich, K.C.I.E., Ph.D., late Inspector-General of Forests to the Government of India. 21, *Kaiser Strasse, Bonn, Germany.*
June 3, 1897.				Broadbent, Sir William Henry, Bart., M.D. (Lond.), F.R.C.P., Consulting Physician to St. Mary's Hospital, and to the London Fever Hospital. 84, *Brook-street*, W.
June 12, 1879.	'91–92			Brown, Alexander Crum, D.Sc., LL.D., Professor of Chemistry in the University of Edinburgh. 8, *Belgrave-crescent, Edinburgh.*
June 6, 1889.				Brown, Horace T., F.C.S., F.I.C. 52, *Nevern-square, South Kensington*, S.W.
June 7, 1883.				Browne, Sir James Crichton, Kt., M.D., LL.D. 61, *Carlisle-place Mansions, Victoria-street*, S.W.
June 4, 1874.	'82–84			Brunton, Thomas Lauder, M.D., Sc.D. (Edin.). 10, *Stratford-place, Oxford-street*, W.; *and Athenæum Club.*

Date of Election.	Served on Council.	Held Office.	Medals.	
June 13, 1895.				Bryan, George Hartley, Sc.D., Professor of Mathematics in the University College of North Wales. *Plas Gwyn, Bangor, N. Wales.*
Dec. 14, 1893.				Bryce, Right Hon. James, D.C.L. 54, *Portland-place*, W.
June 9, 1887.				Buchanan, John Young, M.A., F.R.S.E. 10, *Moray-place, Edinburgh.*
June 11, 1857.	'61–63			Buckton, George Bowdler, F.E.S., F.L.S. *Weycombe, Haslemere, Surrey.*
June 12, 1879.				Buller, Sir Walter Lawry, K.C.M.G., D.Sc. *The Terrace, Wellington, New Zealand.*
June 5, 1890.				Burbury, Samuel Hawksley, M.A. 17, *Upper Phillimore-gardens, Kensington*, W.
June 1, 1893.				Burnside, William, M.A., Professor of Mathematics, Royal Naval College, Greenwich. *The Laurels, Hithergreen-lane*, S.E.
June 7, 1894.				Callendar, Hugh Longbourne, M.A., Professor of Physics in McGill College, Montreal. *McGill College, Montreal, Canada.*
June 8, 1871.	'77–79			Carruthers, William, V.P.L.S., F.G.S., Late Keeper of the Botanical Department, British Museum. 14, *Vermont-road, Norwood*, S.E.
June 9, 1887.				Cash, John Theodore, M.D., Regius Professor of Materia Medica in the University of Aberdeen. 25, *Dee-street, Aberdeen.*
Dec. 14, 1882.				Chamberlain, Right. Hon. Joseph, LL.D. (Cantab.). 40, *Prince's-gardens; and Athenæum Club*, S.W.
June 7, 1894.				Cheyne, William Watson, M.B., F.R.C.S., Professor of Surgery in King's College, London. 75, *Harley-street*, W.
June 3, 1897.				Chree, Chas., M.A. (Lond.), D.Sc., Superintendent of the Kew Observatory. *Kew Observatory, Richmond, Surrey.*
June 2, 1881.	'83–85 '89–91	V.P. '90–91		Christie, William Henry Mahoney, C.B., M.A., Astronomer Royal. *Royal Observatory, Greenwich*, S.E.
June 7, 1888.				Church, Arthur Herbert, M.A. (Oxon.), Professor of Chemistry in the Royal Academy of Arts, Lecturer on Organic Chemistry, Royal Indian Engineering College, Cooper's Hill. *Shelsley, Kew.*
June 6, 1889.				Clark, Latimer, Mem. Inst. C.E. 11, *Victoria-street*, S.W.
June 7, 1888.			R.	Clarke, Alexander Ross, Colonel, R.E., C.B. *Boldrewood, Redhill, Surrey.*
June 8, 1882.	'88–90			Clarke, Charles Baron, M.A. (Cantab.). 13, *Kew Gardens-road, Kew.*
June 4, 1896.				Clarke, Lieut.-Colonel Sir George Sydenham, R.E. 24, *Cheniston-gardens, Kensington*, W.

Date of Election.	Served on Council.	Held Office.	Medals.	
June 6, 1872.				Cleland, John, M.D., D.Sc., Professor of Anatomy in the University of Glasgow. *University, Glasgow.*
June 9, 1848.	'78–80			Clerk, Henry, Major-General, R.A. 40, *St. Ermin's Mansions, Caxton-street, Westminster*, S.W.
June 4, 1868.	'71–73 '85–87 '96–97	V.P. '96–98		Clifton, Robert Bellamy, M.A. (Cantab. et Oxon.), Professor of Experimental Philosophy in the University of Oxford. 3, *Bardwell-road, Banbury-road, Oxford; and Athenæum Club.*
June 4, 1886.				Colenso, Rev. William, F.L.S. *Napier, New Zealand.*
June 4, 1896.				Collie, J. Norman, Ph.D. 16, *Campden-grove, Kensington*, W.
June 4, 1885.	'93–95			Common, Andrew Ainslie, LL.D. (St. And.), D.Sc. 63, *Eaton-rise, Ealing*, W.
June 4, 1891.				Conroy, Sir John, Bart., M.A., F.C.S., Fellow and Bedford Lecturer of Balliol College, Oxford. *Balliol College, Oxford.*
June 6, 1878.				Cotterill, James Henry, M.A., late Professor of Applied Mechanics, Royal Naval College, Greenwich.
June 6, 1878.	'78–79			Crawford, James Ludovic, Earl of, K.T., LL.D. 2, *Cavendish-square*, W.; *and Haigh Hall, Wigan.*
June 4, 1885.				Creak, Ettrick William, Captain R.N. 7, *Hervey-road, Blackheath*, S.E.
June 4, 1868.				Crofton, Morgan William, D.Sc., Fellow of the Royal University of Ireland. 15, *Ambrose-place, Worthing.*
June 4, 1863.	'77–79 '94–96	V.P. '95–96	R. D.	Crookes, S. William, 7, *Kensington-park-gardens*, W.; *and Athenæum Club*, S.W.
April 3, 1879.	'80–81			Cross, Right Hon. Richard Assheton, Viscount, G.C.B., D.C.L. 12, *Warwick-square and Athenæum Club*, S.W.; *and Eccle Riggs, Broughton-in-Furness, Lancashire.*
June 4, 1891.				Cunningham, Daniel John, M.D., D.C.L., Prof. of Anatomy in the University of Dublin. 43, *Fitzwilliam-place, Dublin.*
June 6, 1889.				Cunningham, David Douglas, C.I.E., M.B., Brigade Surgeon Lieut.-Col. Bengal Medical Service; Professor of Physiology in the Medical College, Calcutta. 9, *Loudon-street, Calcutta.*
June 3, 1880.				Dallinger, Rev. William Henry, LL.D., Sc.D. (Dubl.). *Ingleside, Newstead-road, Lee*, S.E.
June 8, 1882.	'94–95			Darwin, Francis, M.A. and M.B. (Cantab.), Reader in Botany in the Univ. of Cambridge. *Wychfield, Huntingdon-road, Cambridge.*
June 12, 1879.	'84–85 '86–87		R.	Darwin, George Howard, M.A., LL.D. (Glasc.), Plumian Professor of Astronomy and Experimental

Date of Election.	Served on Council.	Held Office.	Medals.	
				Philosophy in the University of Cambridge. *Newnham Grange, Cambridge.*
Jan. 24, 1895.				Davey, Right Hon. Horace, Lord, M.A., D.C.L. 86, *Brook-street*, W.; *and Verdley-place, Fernhurst, Sussex.*
June 6, 1867.	'89–91			Dawkins, W. Boyd, M.A. (Oxon.), Professor of Geology and Palæontology in the Victoria University, Manchester. *Woodhurst, Fallowfield, Manchester.*
June 4, 1891.				Dawson, George Mercer, C.M.G., LL.D., Assistant Director of the Geological Survey of Canada. *Sussex-street, Ottawa, Canada.*
June 5, 1862.				Dawson, Sir J. William, C.M.G., M.A., LL.D., late Principal and Vice-Chancellor of McGill University, Montreal. 293, *University-street, Montreal.*
June 6, 1861.	'70–72 '81–83			Debus, Heinrich, Ph.D., Lecturer on Chemistry at Guy's Hospital. 4, *Schlangenweg, Cassel, Hessen, Germany.*
Mar. 3, 1892.				Devonshire, Spencer Compton Cavendish, Duke of, K.G., M.A., LL.D., Chancellor of the University of Cambridge. *Devonshire House, Piccadilly*, W.; *and Chatsworth, Derbyshire.*
June 7, 1877.	'85–86		Rm.	Dewar, James, M.A., LL.D., Pres.C.S., Jacksonian Prof. of Natural Experimental Philosophy in the University of Cambridge, Fullerian Prof. of Chemistry in the Royal Institution. 1, *Scroope-terrace, Cambridge; and Royal Institution, Albemarle-street*, W.
June 4, 1885.				Divers, Edward, M.D., Professor of Chemistry in the Imperial University, Japan. *Hongo, Tokyo, Japan.*
June 4, 1886.				Dixon, Harold B., M.A., F.C.S., Prof. of Chemistry and Director of the Chemical Laboratories in Owens College, Manchester. *Birch Hall, Rusholme, Manchester.*
June 7, 1883.				Douglass, Sir James Nicholas, M. Inst. C.E., late Engineer-in-Chief to the Hon. Corporation of Trinity House. *Stella House, Bonchurch, Isle of Wight.*
June 4, 1896.				Downing, Arthur Matthew Weld, D.Sc. 74, *Vanbrugh-park, Blackheath*, W.
Feb. 22, 1855.				Ducie, Henry John Reynolds-Moreton, Earl of, F.G.S. *Tortworth Court, Falfield, Gloucestershire.*
Feb. 9, 1865.				Dufferin and Ava, Frederick Temple Blackwood,

Date of Election.	Served on Council.	Held Office.	Medals.	
				Marquis of, K.P., G.C.B., D.C.L. *Clandeboye, Co. Down, Ireland.*
June 1, 1876.	'79–81			Dunkin, Edwin, F.R.A.S., formerly Chief Assistant, Royal Observatory, Greenwich. *Kenwyn, Kidbrooke Park-road, Blackheath,* S.E.
June 1, 1893.				Dunstan, Wyndham R., M.A., F.I.C., Director of the Department of Scientific and Technical Research of the Imperial Institute. *Queen Anne's Mansions, St. James's Park,* S.W.
June 3, 1875.				Dupré, August, Ph.D., F.C.S., Lecturer on Chemistry at the Westminster Hospital. *Mount Edgcumbe, Benhill-road, Sutton, Surrey.*
				Dyer (see Thiselton-Dyer).
June 4, 1896.				Elgar, Francis, LL.D. 18, *York-terrace, Regent's-park,* N.W.
June 13, 1895.				Eliot, John, C.I.E., M.A., Meteorological Reporter to the Government of India. *Indian Meteorological Office, Simla.*
June 12, 1873.				Ellery, Robert Lewis John, C.M.G., F.R.A.S., late Government Astronomer, and Director of the Observatory. *Melbourne, Victoria.*
June 4, 1891.				Elliott, Edwin Bailey, M.A., F.R.A.S., Wayneflete Professor of Pure Mathematics in the University of Oxford. 4, *Bardwell-road, Oxford.*
June 1, 1893.				Ellis, William, F.R.A.S., late Superintendent of the Magnetical and Meteorological Department, Royal Observatory, Greenwich. 12, *Vanbrugh-hill, Blackheath,* S.E.
June 3, 1897.				Elwes, Henry John, F.L.S., F.Z.S. *Colesborne Park, Andoversford, Gloucestershire.*
June 3, 1869.				Esson, William, M.A., F.C.S., F.R.A.S., Savilian Professor of Geometry in the University of Oxford. *Merton College; and* 13, *Bradmore-road, Oxford.*
June 8, 1871.	'84–85			Etheridge, Robert, F.R.S.E., F.G.S. 14, *Carlyle-square, Chelsea,* S.W.
June 2, 1864.	'67–68 '73–75 '78–97	TREAS. '78–98 V.P. '74–75		Evans, Sir John, K.C.B., D.C.L., LL.D. *Nash Mills, Hemel Hempstead; and Athenæum Club.*
June 12, 1879.				Everett, Joseph David, M.A., D.C.L., Professor of Natural Philosophy in Queen's College, Belfast. *Derryvolgie Avenue, Belfast.*
June 1, 1893.				Ewart, James Cossar, M.D., Professor of Natural History in the University of Edinburgh. *The University, Edinburgh.*
June 9, 1887.	'96–97		R.	Ewing, James Alfred, Hon. M.A. (Camb.), B.Sc. (Edin.), Professor of Mechanism and Applied

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				Mechanics in the University of Cambridge. *Langdale Lodge, Cambridge.*
June 7, 1866.				Farrar, Very Rev. Frederic William, M.A., D.D., Dean of Canterbury, *The Deanery, Canterbury.*
June 7, 1877.	'95–96			Fayrer, Sir Joseph, Bart., K.C.S.I., M.D., LL.D., Honorary Physician to the Queen. 16, *Devonshire-street, Portland-place*, W.
June 7, 1877.				Ferrers, Rev. Norman Macleod, D.D., Master of Gonville and Caius College, Cambridge. *The Lodge, Gonville and Caius College, Cambridge.*
June 1, 1876.	'86–88		R.	Ferrier, David, M.D., F.R.C.P., Professor of Neuropathology, King's College, London. 34, *Cavendish-square*, W.
June 4, 1886.				Festing, Edward Robert, Major-General, R.E. (retired). Science Museum Director, South Kensington Museum. *South Kensington*, S.W.
June 7, 1883.				Fitzgerald, Prof. George Francis, M.A., D.Sc. 40, *Trinity College, Dublin.*
June 2, 1892.				Fleming, John Ambrose, M.A. (Camb.), D.Sc. (Lond.), Fellow and Professor of Electrical Engineering in University College, London. *University College, Gower-street*, W.C.; *and* 2, *Langland-place, Finchley-road, Hampstead*, N.W.
June 6, 1889.	'95–96 '96–97			Fletcher, Lazarus, M.A. (Oxon.), F.G.S., Keeper of Minerals in the British Museum. *Natural History Museum, Cromwell-road; and* 36, *Woodville-road, Ealing*, W.
June 2, 1864.	'68–70 '76–78 '84–86	V.P. '84–85	R.	Flower, Sir William Henry, K.C.B., D.C.L., LL.D., Director of the Nat. Hist. Departments, British Museum. *Natural History Museum, Cromwell-road, and* 26, *Stanhope-gardens*, S.W.
June 9, 1887.				Forbes, George, M.A., Mem. Inst. C.E., formerly Professor of Nat. Phil. in Anderson's College, Glasgow. 34, *Great George-street*, S.W.
June 4, 1886.	'93–95		R.	Forsyth, Andrew Russell, M.A., Sc.D., Sadlerian Professor of Pure Mathematics in the University of Cambridge. *Trinity College, Cambridge.*
June 2, 1892.				Foster, Clement Le Neve, B.A., D.Sc. (Lond.), Professor of Mining in the Royal College of Science, and H.M. Inspector of Mines. *Min-y-don, Llandudno.*
June 3, 1869.	'70–72 '77–78 '83–85 '91–93	V.P. '91–93		Foster, George Carey, B.A., Professor of Physics in University College, London. 18, *Dalehamgardens, South Hampstead*, N.W.; *and Athenæum Club*, S.W.

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June 6, 1872.	'76–77 '81–97	SEC. '81–98		Foster, Michael, M.D., D.C.L., LL.D., Professor of Physiology in the University of Cambridge. *Great Shelford, Cambridge.*
June 2, 1853.	'57–59 '65–67 '75–77 '86–88 '95–97	FOR. SEC. '95–98 V.P. '87–88	C. R.	Frankland, Sir Edward, K.C.B., D.C.L., LL.D. *The Yews, Reigate-hill, Reigate; and Athenæum Club.*
June 4, 1891.				Frankland, Percy Faraday, Ph.D., B.Sc., Professor of Chemistry in the Mason College, Birmingham. *Mason College, Birmingham.*
June 7, 1877.				Fraser, Thomas Richard, M.D., F.R.C.P. (Edin.), Professor of Materia Medica and Clinical Medicine in the University, Edinburgh. 13, *Drumsheugh-gardens, Edinburgh.*
June 7, 1883.				Frost, Percival, Sc.D. *Fitzwilliam-street, Cambridge.*
June 7, 1894.				Froude, Robert Edmund, Superintendent of the Admiralty Experimental Works, Gosport. *North Lodge, Alverstoke, Gosport.*
Dec. 13, 1883.				Fry, Right Hon. Sir Edward, D.C.L., LL.D. *Failand House, Failand, near Bristol.*
June 2, 1892.				Gadow, Hans Friedrich, Ph.D., M.A., Strickland Curator and Lecturer on the Advanced Morphology of Vertebrata in the University of Cambridge. *Zoological Laboratory, Cambridge.*
June 1, 1893.				Gairdner, William Tennant, M.D., LL.D., Professor of Medicine in the University of Glasgow. *The University, Glasgow.*
June 9, 1859.	'61–63 '67–69 '94–95			Galton, Sir Douglas, K.C.B., D.C.L., LL.D. 12, *Chester-street, Grosvenor-place,* S.W.
June 7, 1860.	'65–66 '70–72 '76–77 '82–84	V.P. '70–72 '76–77 '83–84	R.	Galton, Francis, M.A., D.C.L. 42, *Rutland-gate,* S.W.
June 6, 1872.	'86–88			Gamgee, Arthur, M.D., F.R.C.P. (Edin.). 8, *Avenue de la Gare, Lausanne, Switzerland.*
June 5, 1890.				Gardiner, Walter, M.A., F.L.S., University Lecturer in Botany at Cambridge. 45, *Hill's-road, Cambridge.*
June 3, 1858.				Garrod, Sir Alfred Baring, M.D., Consulting Physician to King's College Hospital, Physician Extraordinary to the Queen. 10, *Harley-street,* W.
June 8, 1882.	'95–97		R.	Gaskell, Walter Holbrook, M.A., M.D., Lecturer in Physiology at Cambridge. *The Uplands, Great Shelford, near Cambridge.*

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June 1, 1865.	'85–87 '89–93	FOR. SEC. '89–93 V.P. '85–87	R.	Geikie, Sir Archibald, Knt., Sc.D., LL.D., Director-General of the Geological Survey of the United Kingdom, and of the Museum of Economic Geology, London. *Geological Survey Office*, 28, *Jermyn-street*, S.W.; 10, *Chester-terrace, Regent's Park*, N.W.
June 3, 1875.				Geikie, James, D.C.L., LL.D., Murchison Professor of Geology and Mineralogy in the University of Edinburgh. 31, *Merchiston-avenue, Edinburgh.*
June 2, 1892.				Giffen, Sir Robert, K.C.B., LL.D. (Glasc.). 9, *Bina Gardens, South Kensington*, S.W.
June 7, 1860.	'86–88		R.	Gilbert, Sir Joseph Henry, M.A., Sc.D., late Sibthorpian Professor of Rural Economy in the Univ. of Oxford. *Harpenden, St. Alban's; and Athenæum Club.*
June 4, 1891.				Gilchrist, Percy Carlyle, A.R.S.M. *Frognal Bank, Finchley-road, Hampstead*, N.W.
June 7, 1883.				Gill, David, LL.D., Her Majesty's Astronomer at the Cape of Good Hope. *Royal Observatory, Cape of Good Hope.*
June 2, 1853.	'63–64 '66–68		D.	Gladstone, John Hall, Ph.D., Sc.D. 17, *Pembridge-square*, W.
Jan. 13, 1881.				Gladstone, Right Hon. William Ewart, D.C.L. *Hawarden, Chester.*
June 7, 1849.				Glaisher, James, F.R.A.S. *The Shola, Heathfield-road, South Croydon.*
June 3, 1875.	'83–84 '90–92			Glaisher, James Whitbread Lee, Sc.D. *Trinity College, Cambridge.*
June 8, 1882.	'92–94			Glazebrook, Richard Tetley, M.A. 7, *Harvey-road, Cambridge.*
June 8, 1882.	'91–93			Godman, Frederick Ducane, F.L.S. 10, *Chandos-street, Cavendish-square*, W.; *and South Lodge, Horsham.*
June 3, 1880.				Godwin-Austen, Henry Haversham, Lieut.-Col., F.G.S. *Shalford House, Guildford.*
June 1, 1865.				Gore, George, LL.D. (Edin.). *Inst. Sci. Research*, 20, *Easy Row, Birmingham.*
Dec. 17, 1896.				Gorst, Right Hon. Sir John Eldon, Q.C., M.A. *Lawford House, Manningtree, Essex.*
Jan. 18, 1872.				Goschen, Right Hon. George Joachim, M.A. 69, *Portland-place*, W.
June 2, 1892.				Gotch, Francis, M.A., B.Sc., Waynflete Professor of Physiology in the University of Oxford. *The Lawn, Banbury-road, Oxford.*
June 9, 1887.				Gowers, Sir William Richard, M.D., F.R.C.P., Consulting Physician to University College Hospital;

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				Physician to the National Hospital for the Paralysed and Epileptic. 50, *Queen Anne-street*, W.
Feb. 3, 1881.				Grant Duff, Right Hon. Sir Mountstuart Elphinstone, G.C.S.I., V.-P.R.G.S. 11, *Chelsea Embankment; and Athenæum Club.*
June 4, 1896.				Gray, Prof. Andrew, M.A. *Penybryn, Bangor, N. Wales.*
June 13, 1895.				Green, Joseph Reynolds, M.A., D.Sc., Professor of Botany to the Pharmaceutical Society of Great Britain. *Arncliffe, Grange-road, Cambridge.*
June 7, 1888.	'96–97			Greenhill, Alfred George, M.A., Professor of Mathematics in the Artillery College, Woolwich. 10, *New Inn*, W.C.
June 6, 1878.				Greenwell, Rev. William, M.A., D.C.L., Canon of Durham. *Durham.*
June 13, 1895.				Griffiths, Ernest Howard, M.A. 12, *Parkside, Cambridge.*
June 7, 1883.				Groves, Charles Edward, F.C.S., F.I.C. 352, *Kennington-road*, S.E.
June 7, 1883.				Grubb, Sir Howard, F.R.A.S. 51, *Kenilworth-square, Rathgar, Dublin.*
June 6, 1867.	'74–76	V.P. '75–76	R.	Günther, Albert C. L. G., M.A., M.D., late Keeper of the Zoological Department in the British Museum. *Lichfield-road, Kew Gardens, Surrey.*
June 3, 1897.				Haldane, John Scott, M.A., M.D., Lecturer in Physiology in the University of Oxford. 11, *Crick-road, Oxford.*
June 4, 1891.				Halliburton, William Dobinson, M.D., B.Sc., Professor of Physiology in King's College, London. 9, *Ridgmount-gardens, Gower-street*, W.C.
Jan. 13, 1887.				Halsbury, Right Hon. Hardinge Stanley Giffard, Lord, M.A., D.C.L. 4, *Ennismore-gardens*, W.
June 4, 1868.	'78–80			Harcourt, Augustus George Vernon, M.A., D.C.L., Lee's Reader in Chemistry at Christ Church. *Cowley Grange, Oxford; and Athenæum Club*, S.W.
Dec. 15, 1881.				Harcourt, Right Hon. Sir William George Granville Venables Vernon, Kt., M.A. *Malwood, Lyndhurst, Hants.*
June 4, 1863.				Harley, Rev. Robert, M.A. *Rosslyn, Westbourne-road, Forest-hill*, S.E.; *and Athenæum Club*, S.W.
June 12, 1884.				Hartley, Walter Noel, F.R.S.E., F.I.C., Professor of Chemistry in the Royal College of Science for Ireland. *Royal College of Science, Stephen's-green, Dublin; and* 36, *Waterloo-road, Dublin.*
June 3, 1897.				Haswell, William, M.A., D.Sc., Challis Professor of Zoology in the University of Sydney. *The University, Sydney, N.S.W.*

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June 2, 1864.				Hay, Right Hon. Sir John Charles Dalrymple, Bart., Admiral, K.C.B., D.C.L. 108, *St. George's-square*, S.W.; *and Craigenveoch, Wigtownshire*, N.B.
June 1, 1876.				Hayward, Robert Baldwin, M.A. *Ashcombe, Shanklin, Isle of Wight.*
June 4, 1891.				Heaviside, Oliver. *Bradley View, Newton Abbots, Devon.*
June 7, 1866.				Hector, Sir James, K.C.M.G., M.D., Director of the Geological Survey, Colonial Laboratory, Meteorological and Weather Departments, and of the New Zealand Institute; Chancellor of the New Zealand University. *Wellington, New Zealand.*
June 6, 1889.				Hemsley, William Botting, A.L.S., Principal Assistant in the Herbarium, Royal Gardens, Kew. *Herbarium, Royal Gardens, Kew.*
June 3, 1875.				Hennessey, John Baboneau Nickterlein, C.I.E., M.A., late Deputy Surveyor General in charge of the Trigonometrical Surveys, Survey of India. *Merrimu*, 18, *Alleyn-park, West Dulwich*, S.E.; *and Athenæum Club*, S.W.
June 3, 1858.				Hennessy, Henry G., M.R.I.A., Professor of Applied Mathematics and Mechanism in the Roy. Coll. of Science for Ireland.
June 4, 1874.	'82-83			Henrici, Olaus Magnus Friedrich Erdmann, Ph.D., LL.D., Professor of Mechanics and Mathematics in the City and Guilds of London Institute. *Central Technical College, Exhibition-road*, S.W.; *and* 34, *Clarendon-road, Notting Hill*, W.
June 2, 1892.				Herdman, William Abbott, D.Sc., F.L.S., Professor of Natural History in University College, Liverpool. *University College, Liverpool.*
June 12, 1884.				Herschel, Alexander Stewart, M.A., D.C.L., Honorary Professor of Physics and Experimental Philosophy in the Durham College of Science, Newcastle-on-Tyne. *Observatory House, Slough, Bucks.*
June 8, 1871.				Herschel, John, Col., R.E., F.R.A.S., late Deputy Superintendent, Great Trigonometrical Survey of India. *Observatory House, Slough, Bucks.*
Jan. 21, 1892.				Herschell, Right Hon. Farrer, Lord, G.C.B., D.C.L., Chancellor of the University of London. 46, *Grosvenor-gardens*, S.W.
June 13, 1895.				Heycock, Charles Thomas, M.A., Lecturer on Natural Science, King's College, Cambridge. 24, *Fitzwilliam-street, Cambridge.*
June 4, 1885.				Hicks, Henry, M.D., Pres.G.S. *Hendon-grove, Hendon*, N.W.

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June 4, 1885.				Hicks, William Mitchinson, M.A., D.Sc., Principal and Professor of Physics in Firth College, Sheffield. *Dunheved, Endcliffe-crescent, Sheffield.*
June 13, 1895.				Hickson, Sidney John, D.Sc., M.A., Professor of Zoology in Owens College, Manchester. *Ellesmere House, Withington, Manchester.*
June 7, 1894.				Hill, Micaiah J.M., M.A., D.Sc., Professor of Mathematics, University College, London. *Lakeview, Northwood, Middlesex.*
June 6, 1872.				Hincks, Rev. Thomas, B.A. *Stokeleigh, Leigh Woods, Clifton, Bristol.*
June 4, 1896.				Hinde, George Jennings, Ph.D. *Ivythorn, Avondale-road, S. Croydon.*
June 7, 1855.				Hippisley, John, F.R.A.S. *Athenæum Club*, S.W.; *and Stoneaston Park, Bath.*
June 1, 1893.				Hobson, Ernest William, D.Sc., Fellow of Christ's College, Cambridge. *The Gables, Mount Pleasant, Cambridge.*
June 13, 1895.				Holden, Henry Capel Lofft, Major, R.A. *The Eaves, Belvedere, Woolwich.*
Apr. 22, 1847.	'53–54 '56–58 '62–64 '70–80 '84–86	PRES. '73–78 V.P. '57–58 '63–64 '78–80 '84–86	C. R. Dw.	Hooker, Sir Joseph Dalton, G.C.S.I., D.C.L., LL.D. *The Camp, Sunningdale, Berkshire.*
June 6, 1878.	'86–87 '91–93		R.	Hopkinson, John, M.A., D.Sc. *Holmwood, Wimbledon*, S.W.
June 4, 1886.			R.	Horsley, Victor Alexander Haden, B.S., F.R.C.S., M.D., Professor of Pathology in University College, London. 25, *Cavendish-square*, W.; *and Athenæum Club*, S.W.
June 3, 1897.				Howes, George Bond, F.L.S., F.Z.S., Professor of Zoology in the Royal College of Science, London. *Ingledene-road, Chiswick*, W.
June 1, 1893.				Howorth, Sir Henry Hoyle, K.C.I.E., D.C.L. 30, *Collingham-place, Cromwell-road*, S.W.
June 12, 1884.				Hudleston, Wilfrid H., M.A., F.G.S. 8, *Stanhope-gardens, South Kensington*, S.W.
June 6, 1889.				Hudson, Charles Thomas, M.A., LL.D. 2, *Barton-terrace, Dawlish.*
June 1, 1865.	'66–68 '69–71 '80–82 '88–89 '95–97	V.P. '70–71 '95–97	Rm. R.	Huggins, Sir William, K.C.B., D.C.L., LL.D. 90, *Upper Tulse-hill; and Athenæum Club*, S.W.
June 3, 1880.			R.	Hughes, David Edward, Past-Pres. Soc. Teleg. Eng. 40, *Langham-street, Portland-place*, W.

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June 6, 1889.				Hughes, Thomas McKenny, M.A., F.G.S., Woodwardian Professor of Geology in the University of Cambridge. 18, *Hills-road, Cambridge.*
June 6, 1867.				Hull, Edward, M.A., LL.D., late Director of the Geological Survey of Ireland, and Professor of Geology in the Royal College of Science. 20, *Arundel-gardens, Notting-hill*, W.
June 8, 1882.				Hutchinson, Jonathan, LL.D., M.D., formerly President of and Professor of Pathology and Surgery in the Royal College of Surgeons. 15, *Cavendish-square*, W.
June 2, 1892.				Hutton, Frederick Wollaston, Captain, F.G.S., C.M.Z.S., Curator of the Canterbury Museum, Christchurch. *Canterbury Museum, Christchurch, New Zealand.*
June 6, 1878.				Jackson, John Hughlings, M.D., Consulting Physician to the London Hospital. 3, *Manchester-square*, W.
Feb. 5, 1891.				Jackson, Right Hon. William Lawies, 27, *Cadogan-square*, S.W.; *and Allerton Hall, Chapel Allerton, Leeds.*
June 4, 1885.				Japp, Francis Robert, M.A., Ph.D., Professor of Chemistry in the University of Aberdeen. *University, Aberdeen.*
June 2, 1864.				Jenner, Sir William, Bart., G.C.B., M.D., Physician in Ordinary to the Queen and to H.R.H. the Prince of Wales. *Greenwood, Durley, Bishop's Waltham.*
June 7, 1894.				Jervis-Smith, Rev. Frederick John, M.A., University Lecturer in Mechanics and Millard Lecturer in Experimental Mechanics, Trinity College, Oxford. 28, *Norham Gardens, Oxford.*
June 2, 1892.				Joly, John, M.A., B.E., D.Sc., Professor of Astronomy in the University of Dublin, and Royal Astronomer, Ireland. 39, *Waterloo-road, Dublin.*
June 7, 1894.				Jones, John Viriamu, M.A., B.Sc., Principal and Professor of Physics in the University College of South Wales and Monmouthshire. 42, *Park-place, Cardiff.*
June 6, 1872.				Jones, Thomas Rupert, F.G.S. 17, *Parson's Green, Fulham*, S.W.
June 7, 1877.	'87–89			Judd, John Wesley, C.B., F.G.S., Professor of Geology in the Royal College of Science, London. 22, *Cumberland-road, Kew; Royal College of Science, South Kensington; and Athenæum Club*, S.W.

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June 5, 1851.	'90–96	PRES. '90–95	C. R.	Kelvin, William Thomson, Lord, D.C.L., LL.D., Professor of Natural Philosophy in the University of Glasgow. *University, Glasgow; Athenæum Club*, S.W.; *and* 28, *Chester-square*, S.W.
June 2. 1881.				Kempe, Alfred Bray, M.A. 2, *Paper-buildings, Temple*, E.C.; *and* 10, *Porchester-square, Hyde Park*, W.
June 9, 1887.	'95–96			Kennedy, Alexander B. W., LL.D., Mem. Inst. C.E., Emeritus Professor of Engineering and Mechanical Technology in University College, London. 1, *Queen Anne-street, Cavendish-square*, S.W.
June 5, 1890.				Kerr, Rev. John, LL.D., Mathematical Lecturer in the Free Church Training College, Glasgow. 113, *Hill-street, Glasgow.*
June 9, 1887.				King, George, C.I.E., M.B., LL.D., Superintendent of the Royal Botanical Gardens, Calcutta, and of the Government Cinchona Plantations, Darjeeling. *Seebpore, Calcutta.*
				Kingsburgh (*see* Macdonald).
June 3, 1897.				Kipping, F. Stanley, D.Sc. (Lond.), Professor of Chemistry, University College, Nottingham. *University College, Nottingham.*
June 9, 1887.	'93–95	V.P. '94–95		Kirk, Sir John, G.C.M.G., K.C.B., LL.D. *Waver-tree, Sevenoaks, Kent; and Athenæum Club*, S.W.
June 3, 1875.	'88–90			Klein, Edward Emanuel, M.D., Lecturer on General Anatomy and Physiology in the Medical School, St. Bartholomew's Hospital. 19, *Earl's Court-square*, S.W.
June 12, 1884.	'94–96			Lamb, Horace, M.A., Professor of Mathematics in the Owens College, Manchester. 6, *Wilbraham-road, Fallowfield, Manchester.*
June 7, 1883.			R.	Langley, John Newport, M.A., Fellow and Lecturer of Trinity College, Lecturer on Histology in the University of Cambridge. *Trinity College, Cambridge.*
June 3, 1875.	'82–83 '88–90 '94–96	V.P. '95–96 '82–83	R.	Lankester, Edwin Ray, M.A., LL.D., Linacre Professor of Human and Comparative Anatomy in the University of Oxford. 40, *Nottingham-place*, W.; *and Athenæum Club*, S.W.
June 7, 1888.	'95–97		R.	Lapworth, Charles, LL.D., F.G.S., Professor of Geology in the Mason Science College, Birmingham. 28, *Duchess-road, Edgbaston, Birmingham.*
June 2, 1892.				Larmor, Joseph, M.A., D.Sc., late Professor of Natural Philosophy in Queen's College, Galway. *St. John's College, Cambridge.*

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June 1, 1854.			R.	Lawes, Sir John Bennet, Bart., D.C.L., LL.D. *Rothamsted, St. Albans.*
June 5, 1890.				Lea, Arthur Sheridan, Sc.D., Lecturer in Physiology of Gonville and Caius College; Assistant Lecturer of Trinity College, and University Lecturer, Cambridge. *Gonville and Caius College, Cambridge.*
June 3, 1880.				Limerick, Charles Graves, Lord Bishop of, D.D., D.C.L. *The Palace, Limerick, Ireland.*
June 7, 1860.	'81–83 '93–97	FOR. SEC. '93–95 PRES. '95–	R.	Lister, Joseph, Lord,—PRESIDENT, F.R.C.S., D.C.L., Emeritus Professor of Clinical Surgery, King's College, London. 12, *Park-crescent, Portland-place*, W.
June 12, 1879.	'91–92	V.P. '91–92		Liveing, George Downing, M.A., Sc.D., Professor of Chemistry, Cambridge. *Newnham, Cambridge.*
June 8, 1882.				Liversidge, Archibald, M.A., F.I.C., Professor of Chemistry in the University of Sydney. *The University, Sydney, New South Wales.*
June 3, 1869.	'74–76 '85–87 '91–93	V.P. '92–93	Rm.	Lockyer, Sir Joseph Norman, K.C.B., F.R.A.S. 16, *Penywern-road*, S.W.; *Observatory House, Westgate-on-Sea; and Royal College of Science, South Kensington*, S.W.
June 9, 1887.	'93–94			Lodge, Oliver Joseph, D.Sc., LL.D., Professor of Physics in University College, Liverpool. 2, *Grove-park, Liverpool.*
June 7, 1894.				Love, Augustus Edward Hough, M.A., Fellow of St. John's College, Cambridge. *St. John's College, Cambridge.*
June 6, 1867.				Lowe, Edward Joseph, F.R.A.S., F.L.S. *Shirenewton Hall, near Chepstow, Monmouthshire.*
June 3, 1858.	'61–63 '70–72 '78–79 '93–94	V.P. '71–72 '78–79 '93–94		Lubbock, Right Hon. Sir John, Bart., D.C.L., LL.D. *High Elms, Down, Kent.*
June 7, 1894.				Lydekker, Richard, B.A. *The Lodge, Harpenden, Herts.*
June 2, 1881.	'94–95			Macalister, Alexander, M.A., M.D., Professor of Anatomy in the University of Cambridge. *Torrisdale, Cambridge.*
June 13, 1895.				McClean, Frank, M.A., LL.D. *Rusthall House, Tunbridge Wells.*
June 1, 1865.				McClintock, Sir Francis Leopold, Admiral, K.C.B., D.C.L., LL.D. 8, *Atherstone-terrace, Gloucester-road*, S.W.
June 3, 1880.				M'Coy, Sir Frederick, K.C.M.G., D.Sc., Professor of Natural Sciences in the University, Melbourne. *Melbourne, Australia.*

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June 9, 1859.				Macdonald, John Denis, M.D., Inspector-General of Hospitals and Fleets, R.N. *Amwell-place, Hassocks, Sussex.*
May 3, 1888.				Macdonald, Right Hon. John Hay Athole, C.B., LL.D., Lord Justice-Clerk of Scotland, and Lord President of the Second Division of the Court of Session. 15, *Abercromby-place, Edinburgh.*
June 13, 1895.				Macewen, William, M.D., LL.D., Professor of Surgery in the University of Glasgow. 3, *Woodside-crescent, Glasgow.*
June 7, 1877.				M^{c}Intosh, William Carmichael, M.D., LL.D., Professor of Natural History in the University of St. Andrews; Director of the University Museum, and of the Marine Laboratory, St. Andrews. 2, *Abbotsford-crescent, St. Andrews, Scotland.*
June 12, 1884.	'92–93			M^{c}Kendrick, John Gray, M.D., LL.D., Professor of Physiology in the University of Glasgow. 2, *Florentine-gardens, Glasgow.*
June 7, 1877.				M^{c}Lachlan, Robert, F.L.S., F.E.S. *Westview*, 23, *Clarendon-road, Lewisham*, S.E.
June 2, 1881.	'87–89			M^{c}Leod, Herbert, F.I.C., F.C.S., Professor of Chemistry in the Royal Indian Engineering College, Cooper's-hill. *The College, Cooper's-hill, Staines.*
June 5, 1890.	'95–97			MacMahon, Percy Alexander, Major, R.A., D.Sc., F.R.A.S. *Artillery College, Woolwich; and Shaftesbury-mansions*, 52, *Shaftesbury-avenue*, W.
June 8, 1882.				Malet, John Christian, M.A., Assistant Commissioner of Intermediate Education, Ireland. *Carbery, Silchester-road, Kingstown, Co. Dublin.*
June 7, 1877.				Mallet, John William, M.D., LL.D. *University of Virginia, Albemarle Co., Virginia, United States.*
June 11, 1857.				Marcet, William, M.D. *Flower-mead, Prince's-road. Wimbledon-park*, S.W.; *and Athenæum Club*, S.W.
June 12, 1873.				Markham, Sir Clements Robert, C.B., P.R.G.S. *Athenæum Club; and* 21, *Eccleston-square*, S.W.
June 4, 1891.				Marr, John Edward, M.A., F.G.S., Fellow and Lecturer of St. John's College, Cambridge, and University Lecturer in Geology. *St. John's College, Cambridge.*
June 13, 1895.				Martin, Sidney, M.D., F.R.C.P., Assistant Physician in University College Hospital, and in the Hospital for Consumption, Brompton. 10, *Mansfield-street, Cavendish-square*, W.
June 2, 1870.	'73–75	V.P. '97–98		Maskelyne, Nevil Story, M.A., F.G.S., late Pro-

Date of Election.	Served on Council.	Held Office.	Medals.	
				fessor of Mineralogy in the University of Oxford. *Basset Down House, Swindon.*
June 2, 1870.				Masters, Maxwell Tylden, M.D., F.L.S. *Mount Avenue, Ealing,* W.
June 3, 1897.				Mathews, George Ballard, M.A., Professor of Mathematics in the University College of North Wales, *University College, Bangor.*
June 12, 1879.				Matthey, George, F.C.S., Assoc. Inst. C.E. *Cheyne House, Chelsea Embankment,* S.W.
June 7, 1877.				Medlicott, Henry Benedict, M.A., F.G.S., late Director of the Geological Survey of India. 43, *St. John's-road, Clifton, Bristol.*
June 4, 1886.	'96–97			Meldola, Raphael, F.C.S., F.I.C., Professor of Chemistry in the Finsbury Technical College, City and Guilds of London Institute. *6, Brunswick-square,* W.C.
June 1, 1876.				Meldrum, Charles, C.M.G., M.A., LL.D., late Director of the Royal Alfred Observatory, Mauritius. *Marine House, Beach-road, St. Luke's, Jersey.*
June 2, 1892.				Miall, Louis Compton, F.L.S., F.G.S., Professor of Biology in the Yorkshire College, Leeds. *Crag Foot, Ben Rhydding, Leeds.*
June 4, 1896.				Miers, Prof. Henry Alexander, M.A. *Magdalen College, Oxford.*
June 4, 1874.				Mills, Edmund James, D.Sc. F.I.C. Young Professor of Technical Chemistry in the Glasgow and West of Scotland Technical College, Glasgow. 60, *John-street, Glasgow.*
June 9, 1887.				Milne, John, F.G.S., late Professor of Mining and Geology in the Imperial College of Engineering, Japan. *Shide Hill House, Shide, Newport, I.W.*
June 13, 1895.				Minchin, George M., M.A., Professor of Mathematics in the Royal Indian Engineering College, Cooper's-hill. *The College, Cooper's-hill, Staines.*
June 3, 1869.				Mivart, St. George, Ph.D., M.D., Professor of the Philosophy of Biology in the University of Louvain. *77, Inverness-terrace,* W.
June 8, 1871				Moncrieff, Sir Alexander, Colonel (late R.A.), K.C.B. 15, *Vicarage-gate, Kensington,* W.; *and Athenæum Club,* S.W.
June 4, 1891.				Mond, Ludwig, Ph.D., F.I.C. *The Poplars,* 20, *Avenue-road, Regent's-park,* N.W.; *and Winnington Hall, Northwich.*
June 5, 1856				Moore, John Carrick, M.A., F.G.S. 113, *Eaton-square,* S.W.; *and Corswall, Strunraer, Wigtonshire.*

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Dec. 15, 1892.				Morley, Right Hon. John, M.A., LL.D. 95, *Elm Park Gardens; and Athenæum Club*, S.W.
June 4, 1896.				Mott, Frederick Walker, M.D. *Pathological Laboratory, Claybury Asylum, Essex.*
June 3, 1880.				Moulton, John Fletcher, Q.C., M.A. 57, *Onslow-square*, S.W.
June 7, 1866.	'83–85 '89–91			Müller, Hugo, Ph.D., LL.D. 13, *Park-square*, N.W.; *Crosby-hill, Camberley, Surrey; and Athenæum Club*, S.W.
June 3, 1897.				Murray, George Robert Milne, F.L.S., F.R.S.E., *Willow House, The Green, Ealing*, W.
June 4, 1896.				Murray, John, Ph.D. *Challenger Lodge, Wardie, Edinburgh.*
June 3, 1875.				Nares, Sir George Strong, Vice-Admiral, K.C.B. 1, *Beaufort-villas, Surbiton.*
June 3, 1897.				Neville, Francis Henry, M.A., Fellow and Lecturer in Natural Science, Sydney College. *Sidney College, Cambridge.*
June 2, 1870.	'79–81 '89–91	V.P. '89–91		Newton, Alfred, M.A., F.L.S., Professor of Zoology and Comparative Anatomy in the University of Cambridge. *Magdalene College, Cambridge.*
June 1, 1893.				Newton, Edwin Tulley, F.G.S., F.Z.S. *Geological Museum, Jermyn-street*, S.W.
June 3, 1897.				Nicholson, Henry Alleyne, M.D., D.Sc., Ph.D., F.G.S, F.L.S., Regius Professor of Natural History in the University of Aberdeen, *Marischal College; and Newthorpe, Queen's-road, Aberdeen.*
June 3, 1880.				Niven, Charles, M.A., F.R.A.S., Professor of Natural Philosophy in the University, Aberdeen. 6, *Chanonry, Old Aberdeen.*
June 8, 1882.	'92–94			Niven, William Davidson, C.B., M.A., Director of Studies in the Royal Naval College, Greenwich. *Greenwich*, S.E.
June 2, 1870.	'84–85 '89–90		R.	Noble, Sir Andrew, Capt., K.C.B., F.C.S. *Jesmond Dene House, Newcastle-upon-Tyne; and Athenæum Club*, S.W.
June 5, 1890.				Norman, Rev. Alfred Merle, M.A., D.C.L., Hon. Canon of Durham. *The Rectory, Houghton-le-Spring, R.S.O., Durham.*
Jan. 8, 1880.				Northbrook, Thomas George Baring, Earl of, G.C.S.I., LL.D., D.C.L. 4, *Hamilton-square*, W.; *and Stratton, Micheldever Station, Hants.*
June 9, 1859.	'64–66 '79–81			Odling, William, M.B., V.P.C.S., Waynflete Professor of Chemistry in the University of Oxford. *Museum; and* 15, *Norham-gardens, Oxford.*
June 4, 1863.	'75–76 '80–82		R.	Oliver, Daniel, LL.D., F.L.S., late Keeper of the

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				Herbarium and Library, Royal Gardens, Kew; Emeritus Professor of Botany, University College, London. 10, *Kew Gardens-road, Kew.*
June 4, 1868.				Onmanney, Sir Erasmus, Admiral, Knt., C.B. LL.D. 29, *Connaught-square, Hyde Park*, W. *and United Service Club.*
June 7, 1855.				Osler, Abraham Follett. *South Bank, Edgbaston Birmingham.*
June 4, 1885.				O'Sullivan, Cornelius, F.I.C., F.C.S. 140, *High-street, Burton-on-Trent.*
June 5, 1851.	'54–56 '60–62 '71–72 '79–81 '88–89	V.P. '71–72 '80–81 '88–89		Paget, Sir James, Bart., D.C.L., LL.D., Serjeant-Surgeon to the Queen, Surgeon in Ordinary to H.R.H. the Prince of Wales. 5, *Park-square West, Regent's Park*, N.W.
June 8, 1882.				Palgrave, Robert Harry Inglis, F.S.S. *Belton, Great Yarmouth.*
June 4, 1863.				Pavy, Frederick William, M.D., LL.D., Consulting Physician and formerly Lecturer on Physiology and Comparative Anatomy and Zoology, and on Medicine, at Guy's Hospital, 35, *Grosvenor-street*, W.
June 2, 1892.				Peach, Benjamin Neeve, F.R.S.E., F.G.S. *Geological Survey Office, Sheriff Court-buildings, Edinburgh.*
June 4, 1896.				Pearson, Professor Karl, M.A. 7, *Well-road, Hampstead*, N.W.
June 2, 1892.				Pedler, Alexander, F.C.S., F.I.C., Fellow of the University of Calcutta; Professor of Chemistry, Presidency College, Calcutta; and Meteorological Reporter to the Government of Bengal. *Presidency College, Calcutta.*
June 7, 1894.				Penrose, Francis Cranmer, M.A., F.R.A.S., Honorary Fellow of Magdalene College, Cambridge. *Colebyfield, Copse Hill, Wimbledon*, S.W.
June 7, 1866.	'79–81 '92–94	V.P. '93–94	D. R.	Perkin, William Henry, LL.D., Ph.D. *The Chestnuts, Sudbury, Harrow.*
June 5, 1890.				Perkin, William Henry, junior, Ph.D., F.I.C., Professor of Organic Chemistry in Owens College, Manchester. *Fairview, Wilbraham-road, Fallowfield, Manchester.*
June 4, 1885.				Perry, John, D.Sc., Professor of Mechanics and Mathematics in the Royal College of Science. *Royal College of Science, S. Kensington*, S.W.
June 4, 1868.				Pettigrew, James Bell, M.D., F.R.C.P. (Edin.), Professor of Medicine and Anatomy and Dean of the Medical Faculty in the University of St. Andrews. *St. Andrews.*

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June 9, 1887.				Pickard-Cambridge, Rev. Octavius, M.A. *Bloxworth, Wareham, Dorset.*
June 5, 1890.				Pickering, Spencer Percival Umfreville, M.A., F.C.S. *Harpenden, Herts.*
April 4, 1889.				Pirbright, Right Hon. Baron Henry de Worms, Lord. 42, *Grosvenor-place*, S.W.; *Henley-park, Guildford.*
June 1, 1876.				Pitt-Rivers, Augustus Henry Lane-Fox, Lieut.-General, D.C.L., F.S.A. *Rushmore, Salisbury.*
June 9, 1848.	'56–58 '74–76 '86–87	V.P. '74–75		Playfair (of St. Andrew's), Right Hon. Lyon, Lord, G.C.B., LL.D. 68, *Onslow-gardens*, S.W.
June 6, 1861.	'63–65 '75–77 '87–89	V.P. '75–76		Pole, William, Mus. Doc. Oxon., Hon. Mem. Inst. C.E. 9, *Stanhope-place*, W.; *and Athenæum Club*, S.W.
June 6, 1889.				Poulton, Edward Bagnall, M.A. (Oxon.), F.L.S., Hope Professor of Zoology in the University of Oxford. *Wykeham House, Banbury-road, Oxford; and St. Helen's Cottage, St. Helen's, Isle of Wight.*
June 13, 1895.				Power, William Henry, Assistant Medical Officer, Local Government Board. *Glenbrook, Greenhithe; and Local Government Board, Whitehall*, S.W.
June 7, 1888.	'94–96			Poynting, John Henry, D.Sc., Professor of Physics at the Mason College, Birmingham. *Foxhill, Alvechurch, Worcestershire.*
June 2, 1881.	'87–89			Preece, William Henry, C.B., Mem. Inst. C.E. *Telegraph Department, General Post Office; and Gothic Lodge, Wimbledon.*
June 3, 1852.	'56–58 '64–65 '75–77 '85–87 '92–93	V.P. '76–77 '86–87		Price, Rev. Bartholomew, D.D., F.R.A.S., Master of Pemb. Coll., Sedleian Prof. of Nat. Phil., and Hon. Fellow of Queen's College, Oxford. *Master's Lodge, Pembroke College, Oxford; and Athenæum Club*, S.W.
June 13, 1895.				Purdie, Thomas, B.Sc., Ph.D., Professor of Chemistry in the University of St. Andrews. *The University, St. Andrews.*
June 4, 1886.	'91–92			Pye-Smith, Philip Henry, M.D., F.R.C.P., Physician to Guy's Hospital. 48, *Brook-street*, W.
June 8, 1871.				Quain, Sir Richard, Bart., M.D., F.R.C.P., President of the General Medical Council, Physician Extraordinary to the Queen. 67, *Harley-street*, W.; *and Athenæum and Union Clubs*, S.W.
June 7, 1888.	'96–97		D.	Ramsay, William, Ph.D., F.I.C., Professor of Chemistry in University College, London. 12, *Arundel-gardens, Notting-hill*, W.

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June 2, 1870.				Ransome, William Henry, M.D., Consulting Physician to the General Hospital, Nottingham. *The Pavement, Nottingham.*
June 12, 1884.				Ransome, Arthur, M.A., M.D., late Professor of Public Health in Owens College. *Sunnyhurst, Dean-park, Bournemouth.*
June 12, 1873.	'77–79 '84–96	SEC. '85–96	R.	Rayleigh, John William Strutt, Lord, M.A., D.C.L., Professor of Natural Philosophy in the Royal Institution. *Terling Place, Witham, Essex.*
June 1, 1876.				Reed, Sir Edward James, K.C.B. *Broadway-chambers, Westminster,* S.W.
June 7, 1883.				Reinold, Arnold William, M.A., Professor of Physics in the Royal Naval College, Greenwich. 28, *Belmont Hill, Lee,* S.E.
June 3, 1880.				Reynolds, J. Emerson, M.D., Sc.D., Professor of Chemistry, University of Dublin. *Burleigh House, Burlington-road, Dublin.*
June 7, 1877.	'82–84		R.	Reynolds, Osborne, M.A., LL.D., Professor of Engineering in Owens College, Victoria University, Manchester. 19, *Lady Barn-road, Fallowfield, Manchester.*
Jan. 13, 1842.				Riddell, Charles James Buchanan, Major-Gen., C.B. *Oaklands, Chudleigh, Devonshire.*
June 4, 1885.				Ringer, Sydney, M.D., Holme Professor of Clinical Medicine, University College, London. 15, *Cavendish-place,* W.
May 24, 1860.				Ripon, George Frederick Samuel Robinson, Marquis of, K.G., D.C.L., F.L.S., 9, *Chelsea Embankment,* S.W.; *and Studley Royal, Ripon, Yorkshire.*
June 5, 1890.				Roberts, Isaac, ScD., F.R.A.S. *Starfield, Crowborough, Sussex.*
June 6, 1878.				Roberts, Samuel, M.A. 53, *Parliament Hill-road, Hampstead,* N.W.
June 7, 1877.	'90–91			Roberts, Sir William, B.A., M.D. 8, *Manchester-square,* W.
June 3, 1875.	'90–92			Roberts-Austen, William Chandler, C.B., F.C.S., Prof. of Metallurgy, Royal College of Science, Chemist of the Royal Mint. *Royal Mint, Tower-hill,* E.; *Chilworth, Guildford; and Athenæum Club,* S.W.
June 4, 1863.	'72–73 '81–83 '88–90	V.P. '81–82 '88–90	R.	Roscoe, Sir Henry Enfield, Knt., D.C.L., LL.D., Emeritus Professor of Chemistry in Victoria University (Owens College). 10, *Bramham-gardens, South Kensington,* S.W.; *and Athenæum Club,* S.W.
June 10, 1886.				Rosebery, Right Hon. Archibald Philip Primrose, Earl of, K.G., D.C.L. 38, *Berkeley-square,* W.; *and Dalmeny-park, Linlithgowshire.*

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Dec. 19, 1867.	'71–72 '87–88	V.P. '71–72 '87–88		Rosse, Laurence Parsons, Earl of, K.P., D.C.L., LL.D., Chancellor of the University of Dublin. *Birr Castle, Parsonstown, Ireland.*
June 6, 1872.	'88–90			Routh, Edward John, D.Sc., LL.D. *Newnham Cottage, Queen's-road, Cambridge.*
June 12, 1884.	'87–89 '94–97	SEC. '96–98	R.	Rücker, Arthur William, M.A., D.Sc., Professor of Physics, Royal College of Science, London. 19, *Gledhow-gardens, South Kensington*, S.W.; *and Athenæum Club*, S.W.
June 4, 1886.				Russell, Henry Chamberlain, C.M.G., B.A., F.R.A.S., Government Astronomer of New South Wales. *The Observatory, Sydney, N.S. Wales.*
June 6, 1872.	'85–86	V.P. '97–98		Russell, William James, Ph.D., V.P.C.S., Lecturer on Chemistry at the Medical School of St. Bartholomew's Hospital. 34, *Upper Hamilton-terrace*, N.W.
June 1, 1876.				Rutherford, William, M.D., F.R.S.E., Professor of Physiology in the Univ. of Edinburgh. *The University; and* 14, *Douglas-crescent, Edinburgh.*
Jan. 28, 1869.	'69–70 '82–83 '92–94	V.P. '82–83 '93–94		Salisbury, The Most Hon. Robert Arthur Talbot Gascoigne-Cecil, Marquis of, K.G., M.A., D.C.L., Chancellor of the University of Oxford. 20, *Arlington-street*, S.W.; *and Hatfield House, Hatfield, Herts.*
June 4, 1863.			C. R.	Salmon, Rev. George, D.D., D.C.L., LL.D., Provost of Trin. Coll., Dublin. *Trinity College, Dublin.*
June 12, 1873.	'82–84 '94–96			Salvin, Osbert, M.A., F.L.S. *Hawksfold, Fernhurst, Haslemere.*
June 2, 1881.	'87–88			Samuelson, Right Hon. Sir Bernhard, Bart., M.P., Mem. Inst. C.E. 56, *Princes-gate*, S.W.
June 6, 1867.	'73–75 '84 86 '93–95	V.P. '74–75 '94–95	R.	Sanderson, J. S. Burdon, M.A., M.D., Regius Professor of Medicine in the University of Oxford. *Physiological Laboratory; and* 64, *Banbury-road, Oxford.*
June 6, 1878.	'90–92			Schäfer, Edward Albert, M.R.C.S., Jodrell Professor of Physiology, University College, London. *Croxley Green, Rickmansworth.*
June 6, 1850.				Schunck, Edward, F.C.S. *Kersal, Manchester.*
June 12, 1879.	'85–87		R.	Schuster, Arthur, Ph.D., F.R.A.S., Professor of Physics in Owens College, Victoria University, Manchester. 4, *Anson-road, Victoria-park, Manchester.*
June 6, 1861.	'72–73 '86–87			Sclater, Philip Lutley, M.A., Ph.D., Secretary of the Zoological Society of London. 3, *Hanover-square*, W.; *and Odiham Priory, Winchfield, Hants.*

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June 7, 1894.				Scott, Dukinfield Henry, M.A., Ph.D., Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew. *Old Palace, Richmond, Surrey.*
June 2, 1870.				Scott, Robert Henry, M.A., F.R. Met. Soc., Secretary to the Meteorological Council. *Meteorological Office*, 63, *Victoria-street; and* 6, *Elm-park-gardens*, S.W.
June 4, 1886.	'92–94			Sedgwick, Adam, M.A., Fellow and Lecturer of Trin. Coll., Cambridge, and Reader of Animal Morphology in the University. *Whitefield, Great Shelford, Cambridge.*
June 12, 1879.				Seeley, Harry Govier, F.L.S., F.G.S., Professor of Geology and Geography with Mineralogy in King's College, London. 25, *Palace Gardens-terrace, Kensington*, W.
June 4, 1874.				Selwyn, Alfred Richard Cecil, C.M.G., F.G.S., late Director of the Geological Survey of Canada. *Sussex-street, Ottawa, Canada.*
June 5, 1890.				Sharp, David, M.B., C.M. (Edin.) *Museum of Zoology, Cambridge; and Hawthorndene, Hills-road, Cambridge.*
June 4, 1891.				Shaw, William Napier, M.A., Fellow and Senior Tutor of Emmanuel College, Cambridge. *Emmanuel College, Cambridge.*
June 1, 1893.				Sherrington, Charles Scott, M.A., M.D., Holt Professor of Physiology in University College, Liverpool. 16, *Grove-park, Liverpool.*
Jan. 9, 1845.	'69–70 '78–80	V.P. '79–80	B.	Simon, Sir John, K.C.B., F.R.C.S., D.C.L., Consulting Surgeon to St. Thomas's Hospital. 40, *Kensington-square*, W.
June 5, 1862.				Simpson, Maxwell, B.A., M.D., late Professor of Chemistry in Queen's College, Cork. 9, *Barton-street, West Kensington*, W.
June 9, 1887.				Snelus, George James, F.C.S., A.R.S.M. *Ennerdale Hall, Frizington, Cumberland.*
June 6, 1889.				Sollas, William Johnson, D.Sc., LL.D., Professor of Geology in the University of Dublin. *Lisnabin, Dartry Park-road, Rathgar, Dublin.*
June 11, 1857.	'76–77		R.	Sorby, Henry Clifton, LL.D., F.L.S. *Broomfield, Sheffield.*
June 6, 1878.				Sprengel, Hermann Johann Philipp, Ph.D., F.C.S., Royal Prussian Professor (titular). *Savile Club*, 107, *Piccadilly*, W.
June 4, 1896.				Stebbing, Rev. Thomas Roscoe Rede, M.A. *Ephraim Lodge, The Common, Tunbridge Wells.*
June 4, 1896.				Stewart, Prof. Charles, M.R.C.S., Hunterian Professor of Human and Comparative Anatomy,

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				Royal College of Surgeons. 38, *Lincoln's Inn Fields*, W.C.
June 1, 1893.				Stirling, Edward Charles, C.M.G., M.D., F.R.C.S., Senior Surgeon, Adelaide Hospital, Lecturer on Physiology in the University of Adelaide. *The University, Adelaide, South Australia.*
June 5, 1851.	'54–92	SEC. '54–25 PRES. '85–90 V.P. '90–92	C. Rm.	Stokes, Sir George Gabriel, Bart., M.A., D.C.L., LL.D., Lucasian Professor of Mathematics in the University of Cambridge. *Lensfield Cottage, Cambridge; and Athenæum Club*, S.W.
June 2, 1881.				Stoney, Bindon Blood, LL.D., M. Inst. C.E. 14, *Elgin-road, Dublin.*
June 6, 1861.				Stoney, George Johnstone, M.A., D.Sc. 8, *Upper Hornsey-rise*, N.
June 1, 1854.	'72–74 '80–81 '84–86 '90–91	V.P. '80–81 '85–86	R.	Strachey, Sir Richard, Lieut.-General R.E., G.C.S.I., LL.D., Chairman Meteorological Council. 69, *Lancaster Gate, Hyde Park*, W.
Mar. 22, 1888.				Sudeley, Charles Douglas Richard Hanbury-Tracy, Lord. *Ormeley Lodge, Ham Common, Surrey.*
June 7, 1894.				Swan, Joseph Wilson, M.A., F.C.S. 58, *Holland-park*, W.
June 6, 1878.				Symons, George James, Sec. Roy. Met. Soc. 62, *Camden-square*, N.W.
June 7, 1888.				Teale, Thomas Pridgin, M.A., F.R.C.S. 38, *Cookridge-street, Leeds.*
June 5, 1890.				Teall, J. J. H., M.A., F.G.S. 2, *Sussex-gardens, West Dulwich*, S.E.; *and Geological Museum, Jermyn-street*, S.W.
Mar. 12, 1896.				Temple, Rt. Hon. Sir Richard, Bart., G.C.S.I. *Heath Brow, Hampstead Heath*, N.W.
June 3, 1869.				Tennant, James Francis, Lieut.-General R.E., C.I.E. 11, *Clifton-gardens, Maida-hill*, W.
June 3, 1880.	'86–88 '96–97	V.P. '96–97		Thiselton-Dyer, William Turner, C.M.G., C.I.E., M.A. (Oxon.), Director, Royal Gardens, Kew. *Royal Gardens, Kew.*
June 4, 1891.				Thompson, Silvanus Phillips, B.A., D.Sc., Principal and Professor of Physics in the City and Guilds of London Technical College, Finsbury. *Morland, Chislett-road, West Hampstead*, N.W.
June 3, 1897.				Thomson, John Millar, Sec. C.S., Professor of Chemistry and Lecturer on Photography in King's College, and Professor of Chemistry in Queen's College, London. 85, *Addison-road*, W.
June 12, 1884.	'89–91		R.	Thomson, Joseph John, M.A., Sc.D., Cavendish Professor of Experimental Physics, Cambridge. *Trinity College, Cambridge.*

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June 5, 1890.				Thorne, Sir Richard Thorne, K.C.B., M.B., F.R.C.P., Medical Officer to H.M. Local Government Board. 45, *Inverness-terrace*, W.
June 1, 1893.				Thornycroft, John Isaac, M. Inst. C.E. *Eyot Villa, Chiswick Mall, Chiswick.*
June 1, 1876.	'90–91 '93–95	V.P. '94–95	R.	Thorpe, Thomas Edward, Sc.D., LL.D, Principal of the Government Laboratories, Somerset House. *Government Laboratories, Somerset House*, W.C.; *and Athenæum Club*, S.W.
June 3, 1869.				Thuillier, Sir Henry Edward Landor, General, R.A., C.S.I., F.R.G.S. *Tudor House, Richmond, Surrey; and Oriental Club*, W.
June 3, 1880.	'92–94			Tilden, William Augustus, D.Sc., F.I.C., Professor of Chemistry in the Royal College of Science, London. 9, *Ladbroke-gardens, Notting-hill*, W.
June 4, 1891.				Tizard, Thomas Henry, Staff-Captain R.N., F.R.G.S. *Hydrographic Department, Admiralty, Whitehall*, S.W.
June 6, 1889.				Todd, Sir Charles, K.C.M.G., M.A., Postmaster-General, Superintendent of Telegraphs and Government Astronomer, South Australia. *The Observatory, Adelaide, South Australia.*
June 6, 1878.				Tomes, Charles Sissmore, M.A. 9, *Park-crescent, Portland-place*, W.
June 6, 1889.				Tomlinson, Herbert, B.A. 88, *Oakley-street, Chelsea*, S.W.
June 1, 1893.				Trail, James William Helenus, A.M., M.D., Regius Professor of Botany in the University of Aberdeen. *The University, Aberdeen.*
June 2, 1881.				Traquair, Ramsay H., M.D., LL.D., Keeper of the Natural History Collections in the Museum of Science and Art, Edinburgh. 8, *Dean Park-crescent, Edinburgh.*
June 7, 1883.				Trimen, Roland, F.L.S., F.E.S., late Curator of the South African Museum. 87, *Gloucester Place*, W.
June 4, 1868.				Tristram, Rev. Henry Baker, D.D., LL.D., Canon of Durham. *College, Durham.*
June 3, 1897.				Trouton, Frederick Thomas, M.A., Sc.D., *Caerleon, Killiney, co. Durham.*
June 3, 1897.				Turner, Herbert Hall, M.A., B.Sc., Sec. R.A.S., Savilian Professor of Astronomy in the University of Oxford, *New College, Oxford.*
June 7, 1877.	'90–91			Turner, Sir William, M.B., D.C.L., Professor of Anatomy in the University of Edinburgh. 6, *Eton-terrace, Edinburgh; and Athenæum Club*, S.W.

Date of Election.	Served on Council.	Held Office.	Medals.	
June 8, 1871.				Tylor, Edward Burnett, D.C.L., LL.D., Professor of Anthropology in the University of Oxford. *Museum House, Oxford.*
June 4, 1886.	'93-94			Unwin, W. Cawthorne, B.Sc., Mem. Inst. C.E., Professor of Engineering at the Central Technical College of the City and Guilds of London Institute. *7, Palace Gate-mansions, Kensington, W.*
June 7, 1894.				Veley, Victor Herbert, M.A., F.C.S. *University College; and 22, Norham-road, Oxford.*
June 7, 1883.				Venn, John, Sc.D. *3, St. Peter's-terrace, Cambridge.*
June 4, 1885.	'90-92			Vines, Sydney Howard, M.A., D.Sc., Sherardian Professor of Botany in the University of Oxford. *Headington-hill, Oxford.*
June 7, 1883.				Walker, John James, M.A., 12, *Denning-road, Hampstead,* N.W.
June 1, 1893.			R. Dw.	Wallace, Alfred Russel, LL.D., D.C.L. *Corfe View, Parkstone, Dorset.*
June 2, 1892.				Waller, Augustus Désiré, M.D., late Fullerian Professor of Physiology in the Royal Institution, Lecturer on Physiology at St. Mary's Hospital Medical School. 16, *Grove End-road,* N.W.
Nov. 22, 1860.				Walpole, Right Hon. Spencer Horatio, Q.C., M.A., D.C.L. 109, *Eaton-square,* S.W.; *and Ealing.*
June 9, 1887.	'96-97			Walsingham, Thomas de Grey, Lord, M.A., LL.D., High Steward of the University of Cambridge. *Merton Hall, Thetford, Norfolk.*
June 7, 1888.	'95-96		R.	Ward, Harry Marshall, D.Sc., F.L.S., Professor of Botany in the University of Cambridge. *Botanical Laboratory, New Museums, Cambridge.*
June 4, 1886.				Warington, Robert, M.A., F.C.S., Sibthorpian Professor of Rural Economy in the University of Oxford. *High Bank, Harpenden, St. Albans.*
June 12, 1884.				Warren, Sir Charles, Major-General R.E., K.C.B., G.C.M.G. *Government House, Chatham; and Athenæum Club,* S.W.
June 2, 1881.				Watson, Rev. Henry William, D.Sc. *The Rectory, Berkeswell, Coventry.*
June 5, 1890.	'96-97			Weldon, Walter Frank Raphael, M.A., Jodrell Professor of Comparative Anatomy and Zoology at University College, London. 30A, *Wimpole-street,* W.
June 4, 1886.	'88-89 '95-97			Wharton, Sir William James Lloyd, Rear-Admiral, K.C.B., F.R.G.S., Hydrographer of the Admiralty. *Florys, Prince's-road, Wimbledon-park; and Athenæum Club,* S.W.

Date of Election.	Served on Council.	Held Office.	Medals.	
June 9, 1887.				Whitaker, William, B.A., F.G.S. *Freda, Campden-road, Croydon.*
June 7, 1888.	'94–95			White, Sir William Henry, K.C.B., LL.D., Assistant Controller and Director of Naval Construction. *The Admiralty, Whitehall,* S.W.; *and Athenæum Club,* S.W.
June 4, 1886.				Wilde, Henry. *The Hurst, Alderley Edge, Cheshire.*
June 2, 1870.				Wilks, Sir Samuel, Bart., M.D., LL.D., Consulting Physician to Guy's Hospital. 72, *Grosvenor-street,* W.
June 5, 1862.				Williams, C. Greville, F.C.S., F.I.C. 36, *Kenilworth-avenue, Wimbledon,* S.W.
June 7, 1855.	'59–61 '69–71 '73–90	FOR. SEC. '73–89 V.P. '89–90	R.	Williamson, Alexander William, D.C.L., LL.D., Emeritus Prof. of Chemistry in Univ. Coll. Lond. *High Pitfold, Shottermill, Haslemere.*
June 12, 1879.				Williamson, Benjamin, M.A., D.Sc., Fellow and Senior Tutor of Trinity College, Dublin. *Trinity College, Dublin.*
June 4, 1874.	'89–90			Wilson, Sir Charles William, Major-General, R.E., K.C.B., K.C.M.G. *Athenæum Club,* S.W.
June 7, 1855.				Wilson, George Fergusson, F.C.S., F.L.S. *Heatherbank, Weybridge Heath, Surrey.*
June 4, 1896.				Wilson, William E. *Daramona, Strete, Rathowen.*
June 12, 1873.				Woodward, Henry, LL.D., P.G.S., Keeper of the Department of Geology, British Museum (Natural History), Cromwell-road, S.W. 129, *Beaufort-street, Chelsea,* S.W.
June 4, 1896.				Woodward, Horace Bolingbroke, F.G.S. 8, *Inglewood-road, West Hampstead,* N.W.
June 1, 1893.				Worthington, Arthur Mason, M.A., F.R.A.S., Headmaster and Professor of Physics, Royal Naval Engineering College, Devonport. 6, *Osborne-villas, Devonport.*
June 4, 1896.				Wynne, William Palmer, D.Sc. 35, *Parson's Green, Fulham,* S.W.
June 6, 1889.				Yeo, Gerald Francis, M.D., F.R.C.S., Emeritus Professor of Physiology in King's College, London. *Bowden, Totnes, South Devon.*
June 1, 1893.				Young, Sydney, D.Sc., F.C.S., Professor of Chemistry in University College, Bristol. 10, *Windsor-terrace, Clifton, Bristol.*
June 3, 1852.				Younghusband, Charles Wright, Lieut.-General, C.B. *Palace Court Mansions, Bayswater-road,* W.; *and Athenæum Club,* S.W.

FOREIGN MEMBERS.

		Elected.
	Agassiz, Alexander. *Museum of Comparative Zoology, Harvard College, Cambridge, Mass., U.S.A.*	1891.
	Amagat, Emile Hilaire. *Ecole Polytechnique, Paris*	1897.
	Auwers, Georg Friedrich Julius Arthur, *Lindenstrasse*, 91, *Berlin*	1879.
D.	Baeyer, Adolf von. *Universität, Munich*	1885.
D.	Berthelot, Marcellin. *Secrétariat de l'Institut, Paris*	1877.
	Bertrand, Joseph Louis François. *Secrétariat de l'Institut, Paris*	1875.
CD.	Bunsen, Robert Wilhelm. *Heidelberg*	1858.
C.	Cannizzaro, Stanislao. *Reale Università, Roma*	1889.
	Chauveau, Jean Baptiste Auguste. *Avenue Jules Janin*, 10, *Paris*	1889.
	Cohn, Ferdinand. *Universität, Breslau*	1897.
Rm.	Cornu, Alfred. *Rue de Grenelle*, 9, *Paris*	1884.
	Cremona, Luigi. *S. Pietro in Vincoli, Rome*	1879.
	Gaudry, Albert. *Rue des Saints-Pères*, 7 *bis*, *Paris*	1895.
C.	Gegenbaur, Carl. *Leopoldstrasse*, 57, *Heidelberg*	1884.
	Gibbs, J. Willard, *Yale College, New Haven, Conn.*	1897.
	Heim, Albert. *Hochschule, Zürich.*	1896.
	Hermite, Charles. *Rue de la Sorbonne*, 2, *Paris*	1873.
	Hoff, J. H. van't. *Universität, Berlin*	1897.
Rm.	Janssen, Pierre Jules César. *Observatoire de Meudon, Paris*	1875.
	Klein, Felix. *Weender Chaussee*, 6, *Göttingen*	1885.
	Koch, Dr. Robert. *Universität, Berlin*	1897.
	Kohlrausch, Friedrich. *Physikalisch-Technische Reichsanstalt, Berlin*	1895.
C.	Kölliker, Albert von. *Universität, Würzburg*	1860.
	Kowalewski, Alexsandr. *Odessa, Russia*	1885.
	Kühne, Willy. *Universität, Heidelberg*	1892.
	Lacaze-Duthiers, Henri de. *Faculté des Sciences, Paris*	1897.
	Langley, Samuel P. *Smithsonian Institution, Washington, U.S.A.*	1895.
	Leuckart, Rudolph. *Universität, Leipzig*	1877.
	Lie, Sophus. *Universität, Leipzig*	1895.
	Lippmann, Gabriel. *Faculté des Sciences à la Sorbonne, Paris.*	1896.
	Mascart, Eleuthère Elie Nicolas. *Rue de l'Université*, 176, *Paris*	1892.
D.	Mendeleeff, Dmitri Ivanovitch. *Université, St. Petersburg*	1892.
	Metschnikoff, Elias. *Institut Pasteur, Paris*	1895.
	Mittag-Leffler, Gösta. *Högskolan, Stockholm*	1896.
C.	Newcomb, Simon. *Nautical Almanac Office, Navy Department, Washington, U.S.A.*	1877.
	Pfeffer, Wilhelm. *Universität, Leipzig*	1897.
	Pflüger, Eduard Friedrich Wilhelm. *Universität, Bonn, Germany*	1888.
	Poincaré, Henri. *École Polytechnique, Paris*	1894.

		Elected.
	Quincke, Georg Hermann. *Friedrichsbau, Heidelberg*	1879.
	Rowland, Henry A. *Johns Hopkins University, Baltimore, U.S.A.*	1889.
	Schiaparelli, Giovanni. *R. Osservatorio Astronomico di Brera, Milan*	1896.
	Strasburger, Eduard. *Universität, Bonn*.....	1891.
	Struve, Otto Wilhelm. *Fahnstrasse, 8, Carlsruhe, Germany* ...	1873.
	Suess, Eduard. *Geologisches Museum, Vienna*	1894.
Rm.	Tacchini, Pietro. *Ufficio Meteorologico Centrale, Roma*.....	1891.
C.	Virchow, Rudolf. *Universität, Berlin*	1884.
C.	Wiedemann, Gustav. *Universität, Leipzig*.....	1884.
	Wislicenus, Johannes. *Universität, Leipzig*.....	1897.
	Zirkel, Ferdinand. *Universität, Leipzig*	1897.

SECTIONAL COMMITTEES, 1898.

1. Mathematics Committee:—

(Two to retire each year.)

Chairman—Prof. G. H. Darwin.

	To serve.				
Prof. Henrici	1 year.	Retires	Dec.,	1898.
„ Darwin	1 „	„	„	„
„ Elliott	2 years.	„	„	1899.
Dr. Hobson	2 „	„	„	„
Prof. Hill	3 „	„	„	1900.
Mr. Love	3 „	„	„	„

2. Physics and Chemistry Committee:—

(Four to retire each year.)

Chairman—Mr. Glazebrook.

	To serve.				
Mr. Glazebrook	1 year.	Retires	Dec.,	1898.
Lord Rayleigh	1 „	„	„	„
Dr. Thorpe	1 „	„	„	„
Prof. Schuster	1 „	„	„	„
Dr. Hopkinson	2 years.	„	„	1899.
Sir J. N. Lockyer	2 „	„	„	„
Prof. Poynting	2 „	„	„	„
„ Tilden	2 „	„	„	„
„ Ramsay	3 „	„	„	1900.
„ G. C. Foster	3 „	„	„	„
Dr. Müller	3 „	„	„	„
Prof. Perry	3 „	„	„	„

3. Geology Committee:—

(Three to retire each year.)

Chairman—Prof. Bonney.

	To serve.				
Dr. H. Hicks	1 year.	Retires	Dec.,	1898.
Prof. Judd	1 „	„	„	„
Gen. Sir R. Strachey	1 „	„	„	„

	To serve.			
Prof. Bonney	2 years.	Retires	Dec.,	1899.
„ Lapworth	2 „	„	„	„
Sir C. R. Markham	2 „	„	„	„
Mr. J. J. H. Teall	3 „	„	„	1900.
Dr. H. Woodward	3 „	„	„	„
„ J. Murray.....	3 „	„	„	„

4. Botany Committee:—

(Two to retire each year.)

Chairman—Mr. Thiselton-Dyer.

	To serve.			
Mr. F. Darwin	1 year.	Retires	Dec.,	1898.
Prof. Vines	1 „	„	„	„
„ Balfour	2 years.	„	„	1899.
Mr. Thiselton-Dyer	2 „	„	„	„
Prof. Ward.....	3 „	„	„	1900.
Mr. C. B. Clarke	3 „	„	„	„

5. Zoology Committee:—

(Three to retire each year.)

Chairman—Prof. Lankester.

	To serve.			
Mr. Beddard.....	1 year.	Retires	Dec.,	1898.
„ Boulenger.....	1 „	„	„	„
„ F. Galton.....	1 „	„	„	„
Prof. A. Macalister	2 years.	„	„	1899.
„ Lankester.....	2 „	„	„	„
„ Weldon.....	2 „	„	„	„
Dr. Sclater.....	3 „	„	„	1900.
Mr. Salvin	3 „	„	„	„
„ Sedgwick.....	3 „	„	„	„

6. Physiology Committee:—

(Four to retire each year.)

Chairman—Prof. Schäfer.

	To serve.			
Prof. Fraser	1 year.	Retires	Dec.,	1898.
„ Horsley.....	1 „	„	„	„
„ Sanderson.....	1 „	„	„	„
„ Schäfer	1 „	„	„	„

	To serve.				
Mr. H. T. Brown	2	years.	Retires	Dec.,	1899.
Prof. Gotch.....	2	„	„	„	„
Dr. Klein	2	„	„	„	„
„ Waller.....	2	„	„	„	„
„ Pye-Smith.....	3	„	„	„	1900.
Prof. McKendrick.....	3	„	„	„	„
„ Sherrington	3	„	„	„	„
Dr. Lea.....	3	„	„	„	„

The President and Officers are *ex officio* members of all Committees, the Scientific Relief Committee and Sectional Committees excepted, and in the case of all Committees (excepting the Scientific Relief Committee, the Joint Permanent Eclipse Committee, and the Sectional Committees) each Committee has power to add to its number; any persons so admitted, and not being Fellows of the Royal Society, to be called "accessory members."

STANDING AND OCCASIONAL COMMITTEES.

Library Committee.

Vice-Chairman—Prof. Carey Foster.

Prof. W. Grylls Adams, Prof. Bonney, Mr. Christie, Prof. Carey Foster, Dr. J. W. L. Glaisher, Prof. McLeod, Dr. H. Müller, Prof. A. Newton, Prof. D. Oliver, Prof. Schäfer, Dr. Sclater, Prof. Silvanus Thompson, and Lord Walsingham, with power to add to their number, and with power to order books to an amount not exceeding £250, and to expend a sum not exceeding £150 in binding books belonging to the Society.

Soirée and House Committee.

Vice-Chairman—Prof. Roberts-Austen.

Mr. Boys, Sir W. Crookes, Sir W. H. Flower, Mr. Francis Galton, Prof. Lankester, Sir J. N. Lockyer, Dr. Mond, Dr. H. Müller, Mr. Preece, Prof. Roberts-Austen, Mr. O. Salvin, Dr. Sclater, Dr. D. H. Scott, Gen. Sir R. Strachey, Prof. Ward, and Prof. Weldon, with power to add to their number.

CATALOGUE OF SCIENTIFIC PAPERS COMMITTEE.

Vice-Chairman—The Treasurer.

Prof. Armstrong, Prof. Judd, Dr. Klein, Sir J. N. Lockyer, Prof. McKendrick, Mr. McLachlan, Prof. McLeod, Dr. Mond, Prof. A. Newton, Mr. Preece, Prof. Roberts-Austen, Dr. Routh, Mr. Sedgwick, Dr. Thorpe, and Prof. Vines, with power to add to their number.

"CHALLENGER" COMMITTEE.

Vice-Chairman—Sir J. D. Hooker.

Sir W. H. Flower, Sir J. D. Hooker, Prof. Lankester, Mr. Salvin, and Mr. Thiselton-Dyer, with power to add to their number.

GUNNING FUND (WATER RESEARCH) COMMITTEE.

Vice-Chairman—Prof. Burdon Sanderson.

Dr. H. Müller, Sir W. Roberts, Prof. Burdon Sanderson, Dr. Thorpe, and Prof. Vines, with power to add to their number.

SCIENTIFIC RELIEF COMMITTEE.

Vice-Chairman—Mr. Carruthers.

Mr. Carruthers, Mr. O. Salvin, Prof. G. Carey Foster, Dr. W. J. Russell, Sir A. Geikie, Dr. Thorpe, Mr. Christie, Prof. Schäfer, Dr. Brunton, and Major MacMahon.

INTERNATIONAL CATALOGUE COMMITTEE.

Vice-Chairman—Prof. Armstrong.

Prof. Armstrong, Dr. W. T. Blanford, Mr. H. T. Brown, Mr. Christie, Prof. Forsyth, Prof. Halliburton, Mr. B. Daydon Jackson, Prof. Lapworth, Sir J. N. Lockyer, Mr. Love, Prof. McLeod, Major MacMahon, Prof. Miers, Dr. Mond, Mr. Salvin, Dr. D. H. Scott, Mr. Sharp, Gen. Sir R. Strachey, Mr. G. J. Symons, Mr. Teall, Prof. Weldon, and Adm. Sir W. J. L. Wharton, with power to add to their number.

JOINT PERMANENT ECLIPSE COMMITTEE.

(On the part of the Royal Society.)

Capt. Abney, Mr. Christie, Dr. Common, Sir W. Huggins, Sir J. N. Lockyer, Major MacMahon, Prof. Schuster, Dr. G. J. Stoney, Gen. Tennant, and Adm. Sir W. J. L. Wharton.

CORAL REEF COMMITTEE.

Vice-Chairman—Prof. Bonney.

Sir J. Wolfe Barry, Prof. Bonney, Sir W. Crookes, Mr. F. Darwin, Sir A. Geikie, Prof. Judd, Dr. J. Murray, Prof. Sollas, Mr. W. W. Watts, and Adm. Sir W. J. L. Wharton, with power to add to their number.

DELTA BORING COMMITTEE.

Vice-Chairman—Prof. Judd.

Sir B. Baker, Dr. W. T. Blanford, Prof. Bonney, Dr. Le Neve Foster, Sir A. Geikie, Prof. Judd, and Prof. Lapworth, with power to add to their number.

TSETSE-FLY COMMITTEE.

Sir J. Kirk, Prof. Lankester, Mr. Salvin, and Prof. Sanderson, with Mr. Blandford, Dr. Durham, and Prof. Kanthack as accessory members, and with power to add to their number.

EVOLUTION COMMITTEE.

Vice-Chairman—Mr. F. Galton.

Mr. W. Bateson, Mr. Burbury, Sir E. Clarke, Mr. F. Darwin, Mr. F. Galton, Mr. F. D. Godman, Mr. W. Heape, Prof. Lankester, Mr. E. J. Lowe, Prof. Macalister, Dr. Masters, Prof. Meldola, Prof. Karl Pearson, Prof. Poulton, Mr. Salvin, Mr. Thiselton-Dyer, and Prof. Weldon, with power to add to their number.

GOVERNMENT GRANT REVIEW COMMITTEE.

Vice-Chairman—Dr. H. Müller.

Dr. Blanford, Prof. Halliburton, Dr. H. Müller, Mr. W. D. Niven, Prof. Reinold, Mr. Salvin, and Dr. D. H. Scott.

OBSERVATORIES COMMITTEE.

Vice-Chairman—Astronomer Royal.

The Astronomer Royal, the President of the Royal Astronomical Society, Capt. Abney, Prof. G. H. Darwin, Sir W. Huggins, Sir J. N. Lockyer, Sir G. G. Stokes, and Gen. Sir R. Strachey.

STATUTES OF THE ROYAL SOCIETY.

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CHAPTER I.

Of the Election and Admission of Fellows.

I. No person shall be proposed, elected, or admitted a Fellow of the Society on the day of the Anniversary Meeting for electing the Council and Officers.

II. Every Fellow, previously to his proposing a person as a Candidate for Election, shall inform him of the Obligation to be subscribed, of the sum to be paid for admission money, and of the payments to be made to the Society, before he can be admitted a Fellow.

III. Every such Candidate shall be proposed and recommended by a certificate in writing signed by six or more Fellows, of whom three at least shall certify their recommendation from personal knowledge. The certificate shall specify the name, rank, profession, qualifications, and usual place of residence of the Candidate; and being delivered to one of the Secretaries, or to the Assistant Secretary,

shall be registered, with the date of delivery, in a book to be kept for the purpose, and read at the next ordinary meeting; and, if so ordered, shall be suspended in some convenient place in the apartments of the Society until the day of election.

IV. Any one of Her Majesty's subjects who is a Prince of the Blood Royal may, nevertheless, be proposed at one of the Ordinary Meetings of the Society by any Fellow, and may be put to the vote for Election on the same day, provided public notice of such proposition shall have been given by the proposer at the preceding Meeting of the Society.

Any Member of Her Majesty's Privy Council may be proposed at any Ordinary Meeting by means of a certificate prepared in accordance with Statute III of this Chapter, no distinction, however, being made between personal and general knowledge, and the fact of the Candidate being a Member of the Privy Council being alone stated as the qualification. Such certificate, on being allowed by the Society, shall be suspended in some convenient place in the apartments of the Society until the day on which a ballot is taken upon it. The date proposed for the ballot, which shall not be earlier than the third Ordinary Meeting after that at which the certificate is read, shall be announced at the head of the certificate.

V. At the first Ordinary Meeting of the Society in March, the names of all Candidates proposed subsequently to the first Meeting in March of the preceding year, including those whose certificates have been resuspended as hereinafter provided, shall be announced by the Secretary from a list arranged in alphabetical order, without reference to the dates of the certificates of the Candidates; and these certificates shall remain suspended until the day of Election.

VI. In the first week in April, a list shall be printed, containing the names of all the Candidates so announced at the first Meeting in March, arranged in alphabetical order, without reference to the dates of the certificates, together with the names of the Fellows by whom each candidate is proposed and recommended; and a copy of such list shall immediately thereafter be sent to every Ordinary Fellow.

VII. The Council shall select by ballot from such printed list of Candidates a number not exceeding fifteen, to be recommended to the Society for Election; but no such selection by the Council shall be valid unless eleven Members at least be present and vote, a majority deciding, or in the event of equality the President having a second or casting vote.

VIII. At the first Ordinary Meeting of the Society in May, the

President shall read from the Chair the names of the Candidates whom the Council have selected as most eligible, arranged in alphabetical order; and after such Meeting, a circular letter shall be forthwith sent to every Fellow, naming the day and hour of Election, and inclosing a printed list of the selected Candidates, with space for such alterations as any Fellow may determine to make in pursuance of Statute X of this Chapter.

IX. The election of Ordinary Fellows not included in the privileged classes referred to in Statute IV of this Chapter, shall take place on the first Thursday of June; unless the Council shall alter the day of Election to any other day in the month of June, in which case due notice of such alteration shall be given to every Ordinary Fellow.

X. On the day of Election two Scrutators shall be nominated by the President, with the approbation of the Society, to assist the Secretaries in examining the lists; and each Fellow present and voting, shall deliver to one of the Secretaries or Scrutators one of the printed lists mentioned in Statute VIII of this Chapter, having erased the name of any Candidate or Candidates for whom he does not vote, and, if he shall have thought fit, having substituted or added the name of any other Candidate or Candidates contained in the printed list sent in pursuance of Statute VI of this Chapter.

XI. One of the Secretaries shall take down the names of the Fellows who vote, and the Scrutators, after examining the lists with the Secretaries, shall report to the President the names of the Candidates who shall have been duly elected in compliance with the Charters, and the President shall announce those names from the Chair.

XII. Any Candidate announced at the first Ordinary Meeting of the Society in March, as aforesaid, who shall not have been elected, shall, if his proposers, or any one of them, so request in writing, continue a candidate; his name shall be placed in alphabetical order with those of the new Candidates to be announced in March following, and his certificate shall be suspended along with those of the new Candidates. Any additional qualifications of such a Candidate may be set forth in a supplementary certificate to be signed by not fewer than six Fellows.

XIII. Every person who is elected a Fellow shall appear for his admission on or before the fourth Ordinary Meeting of the Society after the day of his Election, or within such further time as shall, for some sufficient cause, be granted by the Council; otherwise his election shall be void.

XIV. The admission of any Fellow into the Society shall be at some Ordinary Meeting, in manner and form following, he having first made the payments required by the Statutes. Immediately after the reading of the Minutes has been concluded, he shall subscribe the Obligation in the Charter-book, and be introduced to the President, who, taking him by the hand, shall say these words: *I do, by the authority and in the name of the Royal Society of London, for improving natural knowledge, admit you a Fellow thereof.*

XV. The Election, the payments made previous to admission, and the admission of every person into the Society, with the time thereof, shall be recorded in the Journal-book.

XVI. No person shall be deemed a Fellow of the Society until he has made the payments required by the Statutes: nor shall he be entitled to vote at any Election or Meeting of the Society until he shall have been admitted in the manner and form above specified.

XVII. Persons may be elected into the Society, under the title of Foreign Members, who are neither natives nor inhabitants of Her Majesty's dominions, and shall be exempted from the operation of Chapters II and III of these Statutes; they shall be selected from among men of the greatest eminence for their scientific discoveries and attainments.

XVIII. The Council shall from time to time, as they shall see fit, put in nomination persons for Election as Foreign Members, not exceeding, with those already elected, the number of fifty.

XIX. A book shall be kept in which Members of the Council may enter the names of those men of science whom they suggest as Foreign Members; each entry shall be signed by the proposer and be accompanied by a short statement of the principal grounds on which the suggestion is made, and shall be valid for three years only.

XX. When vacancies are to be filled up, a list of the persons so entered shall be sent to each Member of the Council, together with notice of the Meeting at which the list will be considered. At the Meeting thus appointed further entries may be made, and the claims of those men of science whose names have been duly entered in the book shall be considered, and a selection of names shall be made, from among which the Council, at a subsequent Meeting to be then appointed, may make nominations to the Society.

XXI. At the second Meeting the selection of the Candidates to be

nominated shall be by ballot; when, if two-thirds of the Members of the Council present be in favour of the nomination of any Candidate, his name shall be proposed at the next Ordinary Meeting of the Society, and shall be put to the vote at the following Ordinary Meeting.

CHAPTER II.

Of the Obligation to be Subscribed.

EVERY person elected a Fellow of the Society shall, before his admission, subscribe the Obligation in the following words:—

We who have hereunto subscribed, do hereby promise each for himself, that we will endeavour to promote the good of the Royal Society of London, for improving natural knowledge, and to pursue the ends for which the same was founded; that we will be present at the Meetings of the Society, as often as conveniently we can, especially at the Anniversary Elections, and upon extraordinary occasions; and that we will observe the Statutes and Orders of the said Society. Provided, that whensoever any of us shall signify to the President under his hand, that he desireth to withdraw from the Society, he shall be free from this Obligation for the future.

And if any person elected shall refuse to subscribe the said Obligation, the election of that person shall be void.

CHAPTER III.

Of the Payments to be made by the Fellows to the Society.

I. EVERY person elected a Fellow of the Society shall, before he is admitted, pay the sum of *ten pounds* for admission money, the sum of *four pounds* for the year of his election, and the same sum annually in advance so long as he shall continue a Fellow of the Society. And if any such person shall refuse or fail to pay the said sums, he shall not be admitted, and his Election shall be void: except the said sums be remitted in whole, or in part, by special order of the Council. Provided always that, except in the case of Fellows elected under Statute IV of Chapter I, the admission fee of each Fellow shall be paid out of the Fee Reduction Fund, and shall not be demanded of the Fellow; and that, except in the case of Fellows elected under Statute IV of Chapter I, and Fellows elected before January, 1879, *one pound* of the annual contribution shall be paid out of the Fee Reduction Fund.

II. All who have or may become Fellows of the Society may at any time compound for their annual payments, by paying at once the sum of *sixty pounds*.

III. All Annual Contributions shall be considered to be due on the 25th day of March in each year. Every Fellow of the Society liable to an Annual Payment shall (previously to the 25th day of March in every year) bring or send the same to the Treasurer or the Assistant Secretary. And if any such Fellow, after notice sent by post to his usual address, in May, and again in September, shall fail to pay the same before the first day of October in each year, his name shall be suspended in the public Meeting-room of the Society as being in arrear, and shall continue so suspended until the sum due be paid. And if any such Fellow shall fail to pay his subscription on or before the first day of November in each year, no satisfactory reason having been assigned to the President and Council for such non-payment, he shall cease to be a Fellow of the Society. Provided, nevertheless, that on a solicitation for readmission being addressed to the President and Council by an individual so circumstanced, within the space of one year following St. Andrew's Day, the case of the individual so soliciting shall be stated by the President from the Chair, at one of the Ordinary Meetings of the Society, and the question of his readmission be put to the vote at the next Ordinary Meeting of the Society.

CHAPTER IV.

Of the Death or Recess of any Fellow.

The Death or Recess of any Fellow of the Society shall be recorded in the Journal-book of the Society, and the names of such persons announced from the Chair, at the Anniversary Meeting for electing the Council and Officers.

CHAPTER V.

Of the Causes and Form of Ejection.

I. If any Fellow of the Society shall contemptuously or contumaciously disobey the Statutes or Orders of the Society or Council; or shall, by speaking, writing, or printing, publicly defame the Society; or advisedly, maliciously, or dishonestly do anything to the damage, detriment, or dishonour thereof, he shall be ejected out of the Society.

II. Whensoever there shall appear to be cause for the ejection of any Fellow out of the Society, the subject shall be laid before the Council; and if a majority of the Council shall, after due deliberation, determine by ballot to propose to the Society the ejection of the said Fellow, the President shall in that case, at some Ordinary Meeting of

the Society, announce from the Chair such determination of the Council; and at the Ordinary Meeting next after that at which the said announcement has been made, the Society shall proceed to determine the question; and on its appearing that two-thirds of the Members present have voted for the ejection of the said Fellow, the President shall proceed to cancel his name in the Register, and at the same time pronounce him ejected in these words:—

I do, by the authority and in the name of the Royal Society of London, for improving natural knowledge, declare A. B. to be now ejected, and no longer a Fellow thereof.

And the ejection of every such person shall be then recorded in the Journal-book of the Society; and his name, as ejected, be also read at the next Anniversary Meeting for Elections.

CHAPTER VI.

Of the Election of the Council and Officers.

I. At the two Ordinary Meetings of the Society next preceding the day of the Anniversary Election, the President shall give notice of the said Election; and declare how much it imports the good of the Society, that such persons may be chosen into the Council, as are most likely to attend the Meetings and business of the Council, out of whom there may be made the best choice of a President and other Officers.

II. Every Fellow of the Society whose residence is known, shall have notice of the Anniversary Meeting for electing the Council and Officers for the year ensuing, by particular summons, which summons shall be sent to the place of residence of such Fellow, a week at the least before the day of Meeting, and shall be to this effect:—

These are to give notice, that on the day of the Council and Officers of the Royal Society *are to be elected for the year ensuing; at which Election your presence is expected, at of the clock in the precisely.*

III. The Council for the ensuing year, out of which shall be chosen the President, Treasurer, Principal Secretaries, and Foreign Secretary, shall consist of eleven Members of the existing Council, and of ten Fellows who are not Members of the existing Council.

IV. The President and Council shall, previous to the Anniversary Meeting, nominate, by ballot, eleven Members of the existing Council, and also ten Fellows, not Members of the existing Council, whom they recommend to the Society for Election into the Council for the

ensuing year. The President and Council shall, also, in like manner, nominate by ballot, out of the proposed Council, the persons whom they recommend to the Society for election to the offices of President, Treasurer, Principal Secretaries, and Foreign Secretary for the ensuing year.

V. At the Ordinary Meeting of the Society preceding the Anniversary Meeting, the names of such persons so recommended for election as Council and Officers for the ensuing year shall be announced from the Chair.

VI. Lists, with the names of the Fellows recommended by the President and Council, and having a blank column opposite for such alterations as any Fellow may wish to make, shall be prepared for the use of the Fellows, one week before the day of Election.

VII. Two Scrutators shall be nominated by the President, with the approbation of the Society, to assist the Secretaries in examining the lists.

VIII. Each Fellow voting, shall deliver his list to one of the Secretaries or Scrutators; and the name of each Fellow who shall so deliver in his list shall be noted by one of the Secretaries.

IX. The Scrutators, after examining the lists with the Secretaries, shall report to the Society the names of those having the majority of votes for composing the Council, and filling the offices of President, Treasurer, Principal Secretaries, and Foreign Secretary; the names of which persons shall then be announced from the Chair.

X. For electing any Member of the Council, or any Officer to be elected by the Society, upon such vacancies as shall happen in the intervals of the Anniversary Elections, the summons for such Election, and the proceedings in it, shall be after the same manner as is directed for the Anniversary Election.

XI. Upon any vacancy of the President's place, occurring in the intervals of the Anniversary Elections, the Treasurer, or, in his absence, one of the Secretaries, shall cause the Council to be summoned for the Election of a new President: and the Council meeting thereupon in the usual place, or any eleven or more of them, shall proceed to the said Election, and not separate until the major part of them shall have agreed upon a new President.

CHAPTER VII.

Of the President.

I. THE business of the President shall be to preside at all the meetings, and regulate all the debates, of the Society, Council, and Committees; to state and put questions both in the affirmative and negative, according to the sense and intention of the meetings; to call for reports and accounts from Committees, and others; to check irregularities, and to keep all persons to order; to summon all Meetings of the Council, and Committee of Papers; and to execute, or see to the execution of, the Statutes of the Society.

II. The President shall take precedence of every Fellow of the Society, at their ordinary place of *meeting*; and also in all other places, where any number of the Fellows meet as a Society, Council, or Committee.

III. In the absence of the President, one of the Vice-Presidents shall act as his deputy, and may do, in the absence of the President, the same acts as the President himself could do if present.

CHAPTER VIII.

Of the Treasurer and his Accounts.

I. THE Treasurer, or some person appointed by him, shall receive for the use of the Society, all sums of money due or payable to the Society; and shall pay and disburse all sums due from or payable by the Society; and shall keep particular Accounts of all such receipts and payments.

II. Every sum of money payable on account of the Society, exceeding Ten Pounds, shall be paid only by order of the Council; but payments for rates or taxes, to any amount, may be made by the Treasurer, without any specific order of the Council for that purpose.

III. All sums of money, which there shall not be present occasion for expending, or otherwise disposing of to the use of the Society, shall be laid out in such Government or other securities as shall be approved of and directed by the Council.

IV. The Treasurer shall keep a yearly account of all such Fellows of the Society as pay the sum appointed as the composition in lieu of annual payments; and also of those who make the annual payments: and in this account shall be noted the times up to which the annual payments have been made, and the arrears due from each Fellow.

V. The Treasurer shall also keep a book of Cheque Receipts for annual payments, to be filled up with the name of the Fellow paying, the sum paid, and the time for which payment is made; these Receipts to be signed by the Treasurer, or by the Assistant Secretary receiving the money on the Treasurer's behalf, who, upon the delivery of the Receipt to the Fellow paying, is to enter upon that part of the Cheque which is left in the Book, the above particulars, and also the day of payment.

VI. The Treasurer shall demand, or cause to be demanded, all arrears of annual payments, as soon as convenient after the first day of May.

VII. The Accounts of the Treasurer shall be audited annually, a short time preceding the Anniversary Elections, by a Committee consisting of three Members of the Council, of whom the President or one of the Secretaries to be one; and of three Fellows of the Society not Members of the Council, who are to be nominated by the President, with the consent of the major part of the Fellows present, given by ballot at one of the three next preceding weekly meetings; any one or more of the said three Members of the Council, together with any one or more of the said three Fellows, shall be a Quorum of the said Committee: the Members of the said Committee who are of the Council shall make their Report to the Council held next after such audit, on or before the Anniversary Election; and the Members of the said Committee who are not of the Council shall make their Report to the Society, upon the Meeting next before the Anniversary Election, or on the day of the said Election.

VIII. The Treasurer shall have the charge of the Title Deeds of the Society's Estates, the Policies of Insurance, and Securities.

IX. As soon after the Audit as may be, and before the Anniversary Meeting, the Treasurer shall cause an abstract of the Society's Accounts of the preceding year to be printed for the use of the Fellows.

CHAPTER IX.

Of the Secretaries.

I. The Secretaries, or one of them, shall have inspection over the Assistant Secretary; and shall give the Orders and Directions concerning the entering and writing of all minutes or matters in the Journal-books of the Society or Council, or any other Books of the Society; and also concerning any orders or other writings for the use and service of the Society.

II. The Secretaries, or one of them, shall attend all meetings of the Society, Council, and Committee of Papers; where, when the President has taken the Chair, one of the Secretaries shall read the minutes, orders, and entries of the preceding meeting; and shall afterwards take minutes of the business and orders of the present meeting, to be entered by the Assistant Secretary in the respective books to which they relate.

III. At the meetings of the Society, Lists of the Presents made from time to time to the Society shall be laid on the Table, by one of the Secretaries, for the inspection of the Fellows; and the thanks of the Society to the Donors shall be proposed from the Chair previously to the reading of the first Paper. One of the Secretaries shall give notice of any Candidate who stands proposed for election into the Society at that Meeting; and the Secretaries shall read Letters and Papers presented to the Society, in such manner as the President shall direct.

IV. The Secretaries shall draw up all letters to be written to any persons in the name of the Society or Council (to be read and approved of in some meeting of either respectively), except, for some particular cause or consideration, some other person be appointed by the Society or Council to draw up any such letter. They shall likewise have the charge (under the direction of the Committee of Papers) of printing the *Philosophical Transactions*, the *Proceedings*, and other Publications of the Society.

V. The letters relating to the business of the Society, received during each Session, shall be arranged and kept in the apartments of the Society.

VI. The duty of the Secretary for Foreign Correspondence shall be to receive and answer all letters from foreign parts relating to the business of the Society, to return thanks for Presents from Foreigners made to the Society, and to forward to persons elected Foreign Members the Diplomas certifying their election into the Society.

CHAPTER X.

Of the Assistant Secretary.

I. THE person who shall be chosen to the office of Assistant Secretary, shall either not be a Fellow of the Society; or, if a Fellow, shall cease to be so upon his election to and acceptance of that office.

II. The appointment of a person to the office of Assistant Secretary shall be by the Council, to whom the Officer so appointed shall give security, at the discretion of the Council; and he shall reside in the Society's House.

III. The Assistant Secretary shall be paid for his services according to the determination of the Council; and shall not, besides such payments, receive any perquisite or profit whatsoever without the express permission of the President and Council. He shall be subject to such Rules and Orders as shall from time to time be made or given by the President and Council; and he shall constantly be in attendance during all meetings of the Society, Council, and Committees.

IV. He shall enter all the Minutes in the several Journal-books, and make an Index to every such book: he shall lay before every Council their fair Minute-book: and before every Committee of Papers, the Society's Journal-book, to show that the several entries are fairly made: and he shall have the care of the writing of all Summonses of the Society, Council, and Committees.

V. He shall, under the direction of the Secretaries, have the charge and custody of the Charter-book, Statute-book, Journal-books of the Society and Council, Register-books, and Letter-books, as also of all Papers and Writings belonging to the Society; all which shall be kept in the House of the Society, that they may be in readiness to be produced at any meetings of the Society or Council, as the case may require, or as shall be ordered by the Society, Council, or President.

VI. He shall not suffer any person, not being a Fellow of the Society, to read any Journal-book, Record, or Writing, or any part thereof, belonging to the Society; nor give any copy thereof, nor in any way communicate anything contained therein, to any such person.

VII. He shall follow the directions which may be given him from time to time by the Treasurer in respect of that part of his duties which relates to the Accounts or Cash Transactions of the Society. He shall enter in a book, to be provided by the Treasurer, all such sums as he may receive on account of the Society at the instant of receiving such sums; and for these sums, so entered by him, he shall be answerable, until he shall have paid them to the Treasurer.

VIII. He shall attend the Library at such hours as shall be appointed for him for the accommodation of such Fellows of the Society

as shall come to read the printed books or manuscripts, and of any other person who shall be introduced by a Fellow, either personally or by letter.

IX. He shall mark with the stamp of the Society all books accepted or bought by the Society.

CHAPTER XI.

Of the Meetings of the Society.

I. The Session of the Society shall commence on the third Thursday in November, and end on the third Thursday in June.

II. The Ordinary Meetings of the Society shall be on Thursdays weekly (excepting Christmas, Passion, Easter, and Whitsun weeks, and such other weeks at Christmas and Easter, in each year, as the Council may in the preceding year determine, and also Ascension Day), and shall begin at half-past Four o'clock in the Afternoon precisely.

III. No stranger shall be permitted to be present during the Meeting, unless by invitation of the President, or by his leave or order upon the recommendation of some Fellow.

IV. The business of the Society in their Ordinary Meetings shall be to order, take account, consider, and discourse of philosophical experiments and observations; to read, hear, and discourse upon letters, reports, and other papers containing philosophical matters; as also to view, and discourse upon, rarities of nature and art: and thereupon to consider, what may be deduced from them, or any of them; and how far they, or any of them, may be improved for use or discovery.*

V. No letter, report, or other paper shall be read at any Ordinary Meeting unless it be communicated by a Fellow or Foreign Member; and it shall be the duty of each Fellow or Foreign Member to satisfy himself that any letter, report, or other paper which he may communicate, is suitable to be read before the Society.

VI. The conduct of the Ordinary Meetings shall be in accordance with the Standing Orders determined from time to time by the President and Council, provided always that at the Ordinary Meetings nothing relating to Statutes or management of the Society shall be brought forward or discussed.

* This is the wording of the Statute as given in the Statutes of 1663.

VII. The Anniversary Meeting for the election of the Council and Officers, and the Annual Meeting for the election of Fellows, shall take place at an hour to be determined by the Council.

CHAPTER XII.

Of Special General Meetings of the Society.

I. The President or Council may at any time call a Special General Meeting of the Society when it may appear to them to be necessary.

II. Any six Fellows may, by notice in writing, signed by them, and delivered to one of the Secretaries at an Ordinary Meeting of the Society, require a Special General Meeting of the Society to be convened, for the purpose of considering and determining on the matters specified in such requisition, and the Council shall, within one week after such requisition shall have been so delivered, appoint a day for a Special General Meeting accordingly.

III. One week's notice of any Special General Meeting shall be given to each Fellow resident in the United Kingdom, and such notice shall state the object of such Meeting.

IV. At such Meeting no business shall be brought forward except what shall have been so notified.

CHAPTER XIII.

Of the Publication of Papers.

I. The Members of the Council for the time being shall constitute and be a standing Committee, to be called the Committee of Papers, to whom the consideration of the acceptance, reading, and publication of all papers communicated to the Society shall be referred, and who shall execute their powers in accordance with Standing Orders determined from time to time by the President and Council.

II. The Committee of Papers shall meet at such times as shall be appointed by the President; due and sufficient notice of such meeting having been previously sent to every Member of the Committee.

The publication of papers communicated to the Society, and of such other matters as the President and Council may judge fit to publish, shall take place under Standing Orders determined from time to time by the President and Council, but always in such a way that a proper portion of them shall from time to time be printed and published under the title of the 'Philosophical Transactions of the

Royal Society of London,' and another proper portion under the title of the 'Proceedings of the Royal Society of London,' provided always that the President and Council shall have power to publish either papers or other matter in such form and under such conditions as they may from time to time determine.

III. At a meeting of the said Committee no less number than seven of the Members (of which number the President, or, in his absence, a Vice-President, shall always be one) shall be a quorum.

IV. The decisions of the Committee of Papers shall be determined by the majority of votes of those present and voting, and the voting shall be open, unless the President shall direct that the voting shall be by ballot. In case of an equality of votes, the President shall have a second or casting vote.

The decisions of the Committee shall be duly entered in the Minute-book of the Committee.

V. The *Philosophical Transactions* and the *Proceedings* shall be printed at the sole charge, and for the use and benefit, of the Society, and of the Fellows thereof; to the intent that each of the present Fellows, who actually contributes and pays towards the support of the Society, or who has compounded for such contribution, according to the rules and orders established in relation thereto, or who has for other particular reasons been exonerated and discharged from such contribution by order of the Council, may receive *gratis* (but under proper limitations and restrictions) one copy of such of the *Philosophical Transactions* and of the *Proceedings* as shall be printed as aforesaid; and that all persons who shall hereafter be admitted Fellows shall, under the same conditions, receive, and be entitled to, the like benefit and advantage.

VI. The Assistant Secretary shall deliver *gratis* one of the said copies of the *Transactions* to every Fellow of the Society (except as hereinafter excepted) who shall demand the same, either in person, or by letter.

Provided always, that no Fellow whatsoever of the Society shall be entitled to demand or receive any such copy of the *Transactions*, whose election and payment of Admission fees and regular Contributions shall not have preceded the date of the time appointed for the delivery of the said *Transactions;* neither shall the Executor of any deceased Fellow receive a copy of the *Transactions* published after the death of such Fellow.

Provided also, that no Fellow of the Society shall receive, or be entitled to receive, *gratis*, any copy or copies of the *Transactions*, so

printed as aforesaid, after five years shall have elapsed from the time of the Assistant Secretary's having begun to deliver out such copies respectively; but his neglecting to demand them for so long a time shall be deemed a forfeiture and dereliction of his right thereto: unless the Council for the time being, upon being made acquainted with the reason of such delay, and having regard to the circumstances of the application, and the amount of stock in hand, shall *order* such copies as they may think fit to be so delivered.

VII. The Assistant Secretary shall further cause to be distributed *gratis* to all the Fellows of the Society, by post or otherwise, copies of the *Proceedings* as soon as may be convenient after their appearance.

VIII. If the number of copies of *Transactions* and *Proceedings* so to be printed shall be greater than what will be requisite to supply each of the Fellows with one copy, such supernumerary copies shall be disposed of at such times, and in such manner, as the Council shall direct.

CHAPTER XIV.

Of the Books and Papers of the Society.

I. THERE shall be had and kept a Book, called the *Charter-book*, wherein shall be fairly written the copy of the Charters, all the Royal Grants on the behalf of the Society, and the Obligation to be subscribed by the Fellows of the Society in their own hand-writing.

II. There shall be kept a Book, called the *Statute-book*, wherein shall be fairly written, or printed, all the Laws, Statutes, and Constitutions made, or to be made, concerning the government and regulating of the Society or Council; and also a Register of the Fellows of the Society, with the times of their Election and Admission.

III. There shall be kept *Journal-books** of the Society, and also of the Council, wherein shall be entered all the minutes, orders, and business of the Society and Council at their respective meetings; to which Journal-books any Fellow may have access at such times as the Library is open.

IV. A Book shall be kept, in which the title of each communication received, the date of its reception at the apartments of the

* "The words 'Journal-books' do not include the Minute-books of the Government Grant Committee or those of the Government Grant Boards."—*Minute of Council, May* 24, 1894.

Society, and the name of the Fellow or Foreign Member who communicates it, shall be duly entered in the order of its reception.

V. The original copy of every Paper received at the Society shall be considered the property of the Society, if there be no previous engagement with its author to the contrary; but any author may withdraw a paper which has been received but not read; or may, by leave of the Council, have a copy of his paper; and it shall be in the power of the Council, if they think fit, to return to any author such drawings or other illustrations accompanying any paper communicated by him or on his behalf, which he may ask in writing to be returned to him.

VI. All the Papers not withdrawn by leave of the Council, and read at the Society, shall be delivered to the Committee of Papers; and all Papers which have not been printed in the *Transactions* or *Proceedings* shall be preserved in the archives of the Society for future inspection; and shall never be lent out of the Society's House without Order of the Council.

VII. The Library shall be open to the Fellows every week-day (exclusive of Good Friday and Easter-eve, of Easter week, of a week at Whitsuntide, and of a week at Christmas), from 11 A.M. to 6 P.M., except on Saturdays, when it shall be open from Eleven in the morning to One in the afternoon; but during the months of August and September it shall be closed on week-days, other than Saturdays, at 4 p.m.

VIII. Any Fellow may have the loan of any of the printed Books of the Society, excepting such as the Council shall order not to be taken out of the Library; but he shall not be allowed to have in his possession more than ten volumes at a time. The loan of Manuscripts is exclusively vested in the President and Council.

IX. A List of all Books and Manuscripts borrowed from the Library of the Royal Society, and of the Fellows of the Society to whom they are lent, shall be kept in the Library.

X. All Books whatsoever belonging to the Society shall be returned at a time to be specified by the Council, in each year; and the Library shall be closed for one month after such time, or for such shorter periods as the Council may direct.

XI. The value of such Books in the possession of any Fellow as are not returned to the Library pursuant to the preceding Statute, shall be required to be paid by the person who has so detained them.

CHAPTER XV.

Of the Common Seal and Deeds.

I. The Common Seal of the Society shall be kept in a box, the key of which shall be kept in a sealed packet. When the Common Seal has to be used, this packet shall be opened by the President in Council; and at the Council meeting at which it is so opened, the Common Seal having been replaced in the box, and the box locked, the key shall again be enclosed in a packet, which shall be sealed by the President with his private seal. The box and sealed packet shall be kept at the Society's chambers in an iron safe.

II. Every Deed or writing, to which the Common Seal is to be affixed, shall be passed and sealed in Council.

CHAPTER XVI.

Of the Restraint of Dividends to Fellows.

The Society shall not, and by its laws may not, make any Dividend, Gift, Division, or Bonus in Money unto or between any of its Members.

CHAPTER XVII.

Of the Making and Repealing of Laws.

I. For the making of any Law or Statute of the Royal Society, the draught thereof shall be read in Council, and put to the vote, on two several days of their meeting. The first day the question to be resolved by vote shall be to this effect, viz., "Whether the draught of the said Statute, then agreed upon, shall be read at another meeting?" The second day the question shall be to this effect, viz., "Whether the draught of the said Statute, then agreed upon, shall pass for a Law, or not?"

II. For the repealing of any Law or Statute, or any part thereof, the Repeal shall be proposed and voted in Council on two several days of their meeting. The first day the question to be resolved by Ballot shall be to this effect, viz., "Whether the Repeal of such a Statute, or such part thereof, shall be proposed at another meeting?" The second day the question shall be to this effect, viz., "Whether such a Statute, or such part thereof, shall be repealed, or not?" And in case the said Repeal be agreed unto, the same

shall be recorded in the Journal-book of the Council; and the Statute, or part of the Statute, repealed, shall be cancelled in the Statute-book.

January 1, 1897.

STANDING ORDERS OF COUNCIL RELATING TO MEETINGS, SECTIONAL COMMITTEES, AND PUBLICATIONS.

(*As amended to May* 21*st*, 1896.)

NOTE.

By Statute XIII, 1, the consideration of the acceptance, reading, and publication of all papers communicated to the Society is referred to the Council sitting as Committee of Papers; and in the following Standing Orders the word "Council," when used in connection with the acceptance, reading, or publication of papers, is to be understood to mean the Council sitting as Committee of Papers.

I.

Relating to the Conduct of Ordinary Meetings.

1. At each Ordinary Meeting, any formal business of the Society which may be necessary, such as the reading of certificates, balloting for candidates under Cap. I. Sec. IV., announcements, returning thanks for presents, &c., shall, unless the President direct otherwise, be the first business of the meeting.

2. At each Ordinary Meeting, not being "a Meeting for Discussion," as hereinafter provided, or for the Bakerian or the Croonian Lecture, the President shall determine what papers are to be read, and the order in which they shall be taken. He may also, whenever he sees fit, direct the author of a paper or one of the Secretaries to read an abstract of the paper or the paper itself, if it be sufficiently brief, or may invite the author to make an oral statement of the nature of its contents, and may also invite remarks upon the paper. When an oral statement is desired, the author shall, so far as possible, be previously informed of the fact. A paper shall be considered to have been "read" if one of the Secretaries has read its title only.

3. At any Ordinary Meeting, not being a "Meeting for Discussion," any Fellow of the Society may, with the approval of the President, and at such period of the Meeting as the President may determine, make a communication not of the nature of a "paper," or exhibit objects having relation to the advancement of Natural Knowledge.

4. The President shall further have power at any Ordinary Meeting, and at any period of that Meeting which he may think proper, to make such announcements or statements, as he may think desirable, relating to the advancement of Natural Knowledge.

5. In each year certain Ordinary Meetings, not more than four in number (exclusive of the Meetings set aside for the Bakerian and Croonian Lectures respectively), shall be devoted each to the hearing and consideration of some one important communication, or to the discussion of some important topic; these Meetings shall be termed "Meetings for Discussion."

6. The Council shall from time to time give due notice of the dates at which Meetings for Discussion will be held.

7. The Council, of its own motion, or upon the recommendation of a Sectional Committee, may select some communication made to the Society in the ordinary way, as the subject for such a Meeting for Discussion, or it may select for that purpose some question, the discussion of which would, in their judgment, be likely to advance Natural Knowledge. In the latter case, the Council shall appoint some person to open the discussion by means of a communication made by him for that purpose.

8. When a Meeting for Discussion has been arranged, the Council, or the Officers, shall direct printed copies of the communication which has been approved of for the said Meeting (or of an adequate abstract of it), to be sent not later than one week before the date of the Meeting, to each Fellow, or to certain Fellows of the Society, and to such other persons as the President may direct. And the Council shall take such other steps as may seem to it desirable to render the discussion useful towards the advancement of Natural Knowledge.

9. At each Meeting for Discussion, the conduct of the discussion shall be under the direction of the President, who shall arrange for the Fellows present and desiring to speak, and who shall have the power to invite, if he think fit, persons present, not Fellows of the Society, to take part in the discussion. Any Fellow shall be at liberty to send to the Secretaries, previous to the Meeting, written remarks on the communication which is the subject of the meeting, and the President shall, if he see fit, direct one or other of the Secretaries to read these remarks at the meeting.

II.

Relating to Sectional Committees.

10. The Council shall appoint, from among the Fellows of the Society, Committees representing the several branches of Natural Knowledge, and called "Sectional Committees." The Members of each Committee shall be chosen with a view to secure, so far as is possible, a representation of the several sub-divisions of each branch of Natural Knowledge, and to obtain the assistance of Fellows who, from their connection with other societies, and otherwise, are specially qualified to advise the Council in respect to particular parts of Natural Knowledge.

11. It shall be the business of each Sectional Committee to advise the Council (whether sitting as the Committee of Papers or otherwise) or the Officers upon matters referred to it by the Council or by the Officers, and otherwise to make to the Council such suggestions as it may think desirable touching the branch or branches of Natural Knowledge which it represents, it being understood that no Sectional Committee shall offer advice to the Council as to the selection of candidates for admission into the Society as Fellows or Foreign Members, or as to the awards of Medals, unless the Council shall have asked for such advice.

12. The Council shall each year appoint a Member of each Committee to serve as Chairman of that Committee, and to be the channel of communication between the Committee and the Council or Officers.

13. The Sectional Committees shall be six in number, viz.:—

(1) A "Mathematics" Committee for Mathematics, Mathematical Physics, Crystallography, and Mathematical Astronomy.
(2) A "Physics and Chemistry" Committee for Experimental Physics, Observational Astronomy, Meteorology, Chemistry, and Metallurgy.
(3) A "Geology" Committee for Geology, Palæontology, Mineralogy, and Geography.
(4) A "Botany" Committee for Botany.
(5) A "Zoology" Committee for Zoology and Comparative Anatomy.
(6) A "Physiology" Committee for (Animal) Physiology and Medical Subjects.

14. The "Mathematics" Committee shall consist of six Members, of whom two shall retire each year; three Members shall form a quorum.

The "Physics and Chemistry" Committee shall consist of twelve Members, of whom four shall retire each year; five Members shall form a quorum.

The "Geology" Committee shall consist of nine Members, of whom three shall retire each year; four Members shall form a quorum.

The "Botany" Committee shall consist of six Members, of whom two shall retire each year; three members shall form a quorum.

The "Zoology" Committee shall consist of nine Members, of whom three shall retire each year; four members shall form a quorum.

The "Physiology" Committee shall consist of twelve Members, of whom four shall retire each year; five members shall form a quorum.

15. Any Member of Council who desires to attend the meetings of any Sectional Committee, of which he is not at the time being a Member, shall have power to do so as *amicus curiæ* under the following conditions. Upon his expressing in writing to the Assistant Secretary his wish so to attend, the summons for each meeting of the Committee shall be sent to him as to an ordinary Member of the Committee during his tenure of office as Member of Council, or during such shorter time as he may name; but the Chairman of the Committee shall not be expected to correspond with him as with an ordinary Member of Committee. He may with the consent of the Chairman speak during the deliberations of the Committee, but shall give no vote.

16. It shall be in the power of the Council to add to the number of any Committee, if at any time it may seem to be desirable to do so.

(*The following Standing Orders*, 17—28, *are the same for each Sectional Committee.*)

17. The retirement of Members shall be determined by seniority.

18. The retiring Members of the Committee shall each year vacate office on the 31st of December, and shall not be eligible for election for the ensuing year.

19. Should, by reason of death or otherwise, a vacancy occur at any intermediate time, the Council shall appoint a person to fill the vacancy, and the retirement of the person so appointed shall be according to the rules which would have applied to the Member whose place he fills, provided that, if at the date of retirement the said person has not served more than one year, he shall be eligible for immediate re-appointment.

20. The appointment of the Fellows to serve as new Members of Committee shall be made by the Council in December, and the

Members so appointed shall enter office upon the 1st of January ensuing.

21. The Committee shall, when necessary, meet in the apartments of the Society at some convenient hour on the second Thursday in each month from October to July, both included, or at such other times and places as the Chairman may determine.

22. The summonses for a meeting shall be issued by the Assistant Secretary at the direction of the Chairman.

23. The decisions arrived at by a meeting of a Committee at which the Members present do not form a quorum shall be valid, if subsequently agreed to in writing by not less than two-thirds of the whole Committee.

24. Voting shall be open, unless any Member of the Committee shall demand the ballot. The Chairman shall have a second or casting vote.

25. The Minutes of the Committee shall be duly recorded in a book kept for that purpose, and preserved in the apartments of the Society, or in the custody of the Chairman, together with such correspondence and documents relating to the business of the Committee as the Committee may think it desirable to preserve.

26. The Committee shall make to the Council, through its Chairman, who shall be provided by the Society with such clerkly assistance as he may need, reports to the Council, answers to inquiries of the Council, and such suggestions as the Committee may think desirable. The minutes of the Committee shall be laid before the Council whenever the Council shall so demand.

27. When a Committee is of opinion that a paper referred to it might profitably serve as the basis of a discussion at a meeting of the Society, it shall forthwith report to that effect to the Council. If the matter seem urgent, the President and Officers shall have power, without waiting for a Meeting of the Council, to take immediate steps towards carrying out the recommendations of the Committee.

28. Should, at any time, a Committee be of opinion that it would be desirable to encourage a discussion at a meeting of the Society upon some subject, concerning which no paper suitable to serve as a basis for discussion is under its consideration, and have ascertained that some person is willing to prepare a suitable paper for that purpose, the Committee, having approved of the said paper, shall recommend it to the Council, to be treated as the basis of a discussion to be held at some convenient meeting.

III.

Relating to the Acceptance, Reading, and Publication of Papers.

29. Upon a communicated paper reaching the apartments of the

Society, the Assistant Secretary shall mark on it the date of the reception, shall record the reception in the book kept for that and other purposes relating to papers received, and shall report the reception to the one or the other of the two Secretaries, according to the nature of the communication.

30. The Secretary to whom the paper is thus reported shall, if he sees fit, of himself, or after consultation with the other Officers or with the Chairman of the appropriate Sectional Committee, direct the paper to be marked as "accepted for consideration" otherwise he shall refer the question of acceptance for consideration to the appropriate Chairman of Sectional Committee, who shall at a meeting of his Committee, or by correspondence with its Members, obtain the view of the Committee thereupon, and report the same to the Secretary, who shall act on the advice so given.

31. In the case of a paper not being accepted for consideration, the Fellow communicating the paper shall be informed thereof, but the paper itself shall remain the property of the Society, provided always that such Fellow may, with the consent of the Council, withdraw the said paper, upon the understanding expressed in writing that the paper is to be regarded as not having been communicated to the Society at all.

As to the "Proceedings."

32. In the case of a paper being accepted for consideration, the author shall be required to furnish, if he has not already done so, a short account of the main points of the paper, hereinafter called an "abstract," of such length and nature as shall be approved of by the Secretaries; provided that if the paper do not exceed in length about twelve pages of the "Proceedings" (such a paper being hereinafter called a "short" paper), an abstract of it shall not be required.

33. In the case of a paper accepted for consideration, and of which when required an abstract has been furnished, the Secretaries shall proceed to make arrangements for the reading of the paper, and shall, if they think fit, of themselves, or after consultation with the Chairman of the appropriate Sectional Committee, mark the abstract or short paper as suitable for publication in the "Proceedings"; otherwise they shall refer the question of publication of the abstract, or in the case of a short paper, of the paper itself, to the Chairman of the appropriate Sectional Committee, who shall, either at a meeting of the Committee, or by correspondence with its Members, obtain the view of the Committee thereupon, and report the same to the Secretaries, who shall act upon the advice so given.

34. In all cases where the Secretaries have, as regards the acceptance or reading of any paper, or the publication of any abstract or

paper, acted under Standing Order 30, or 33, of themselves, or after consultation with a Chairman of Committee only, the Committee itself not having been formally consulted in the matter, such action shall be reported to the Committee.

35. When a paper has been accepted for consideration, and appointed to be read, the author shall be informed of the meeting at which it is appointed to be read, and shall be supplied with a copy of Standing Order 2. In cases where the President or Secretaries, after consultation (if they see fit) with the appropriate Sectional Committee or its Chairman, are of opinion that at the meeting the author of the paper should be invited to make an oral statement, or that the abstract (or short paper) prepared for publication in the "Proceedings" should be read, the author shall be informed of the fact, and be invited to be present

36. Abstracts of papers, or short papers in full, which have been marked as suitable for publication in the "Proceedings," shall be set up in type without delay, and proofs submitted to authors for correction.

37. The "Proceedings" of the Royal Society shall be published in numbers which shall be issued at as short intervals as may be found suitable, and shall contain:—

i. In reference to each meeting, a record of the formal business conducted at the meeting, the titles of the papers read at the meeting, and such an account of other communications made at the meeting or of other proceedings, not of the nature of business or of discussions on the papers read, as the President and Officers may judge it desirable to insert.

ii. Such abstracts of papers or such short papers ordered for publication in the "Proceedings," as may be ready to be published.

iii. Such papers, not of the nature of short papers, or such other matter as the Council may, in special cases, order to be published in the "Proceedings."

38. The Secretaries shall take what means they may think proper to secure that the account given in the "Proceedings" of any communication made at a meeting besides the papers read, or of anything which occurred and seemed worthy of being recorded, shall be accurate; and if, from anything which takes place at a meeting, they should have reason to think that the Sectional Committee might wish, in respect to any paper, to reconsider the recommendation that it should be published, they shall have power to postpone the publication of that abstract or paper, and refer the abstract or paper once more to the Sectional Committee.

39. The account given in the "Proceedings" of a "Meeting for Discussion" shall contain the communication made for the purpose of

opening the discussion (Standing Order 7), as well as such contributions to the discussion received in writing previous to meeting (Standing Order 9) as the respective authors may desire to see so published, provided always that all such communications are subject to the General Standing Orders relating to the publication of papers in the "Proceedings." There shall be no report of the discussion itself.

As to the "Philosophical Transactions."

40. Every paper communicated to the Society, and accepted for consideration, shall be referred by the Secretaries to the appropriate Sectional Committee through the Chairman of that Committee, provided always that, for the better expedition of the business of the Society, the Secretaries, as provided above (Standing Orders 33 and 36), shall have power, in the case of short papers, to proceed with the reading and publication of a paper previous to its having been considered by a Committee. If the said Chairman is of opinion that the subject of the paper does not lie within the scope of his Committee, he shall report the same to the Secretaries, who shall refer the paper to some other Sectional Committee. Should the Secretaries be of opinion that a paper pertains by its subject to more than one Sectional Committee, they shall take steps in order that the judgment of the several Committees concerned may be obtained. In the case of any difficulty as to the reference of a paper to its appropriate Sectional Committee or Committees, the Secretaries shall bring the matter before the Council.

41. The Chairman through whom the paper is referred shall bring the paper under the consideration of his Committee at the next regular meeting of the Committee, or at some earlier meeting which he may think it desirable to call, having in the meanwhile, if he and one or other of the Secretaries judge it desirable, submitted the paper to one or more Members of the Committee, or Fellows of the Society not Members of the Committee, whose opinion or opinions he shall report to the Committee.

The Sectional Committee, for its guidance in judging a paper so brought before it, shall obtain from at least two persons—who are knowing and well skilled in the particular branch of Natural Knowledge to which the said paper relates, and who may or may not be Members of the Committee, but, unless there be special reasons to the contrary, must be Fellows of the Society—acting as referees, opinions in writing upon the following points, viz.:—

i. Whether the paper should or should not be published in the "Philosophical Transactions";

ii. Whether, in the former case, it should be published in full or in part only, the part so to be published being indicated;

iii. Whether any modifications are necessary or desirable, and, if so, of what nature;

iv. Which illustrations (if any) accompanying the paper should be reproduced.

Having obtained and considered such written opinions, and having, if it see fit, consulted another Sectional Committee or others of the Sectional Committees, and having at a meeting (in accordance with Standing Orders 23, 24) decided upon the above points, it shall embody its decisions, together with any other recommendations which it may think fit to make in reference to the paper, in a Report to the Council, signed by the Chairman, to which Report shall be appended, for inspection by the Council, the written opinions of the Referees.

42. The Sectional Committee, in thus deciding upon a paper, shall be guided by the principle that such a paper only should be recommended for the "Philosophical Transactions" as appears to mark a distinct step in the advancement of Natural Knowledge.

43. If the Council approves of the Report of the Sectional Committee, the Secretaries shall immediately take action with regard to the publication of the paper, in accordance with the Report. If the Council does not approve of the report of the Sectional Committee, it shall request the Sectional Committee to reconsider its recommendations, and shall not come to a decision until it has received the further report of the Sectional Committee. But, for the better expedition of the business of the Society, the Secretaries, in such cases as they judge fit, shall have power to take steps with regard to the publication of a paper in the "Philosophical Transactions," in accordance with the decision of a Sectional Committee, previous to that decision having been brought before the Council; and they shall also have power, in cases in which they and the Chairman of the appropriate Sectional Committee agree in thinking it desirable, to take such steps as they may think fit with regard to the publication of a paper in the "Philosophical Transactions," previous to a formal decision of the said Committee upon the paper having been taken.

44. Each paper ordered for publication in the "Philosophical Transactions" by the Council shall be published separately in paper covers, the date at which it is issued being marked on the cover, and shall be sold separately.

45. The several papers shall also be issued bound in two series—A, containing those papers which are of a mathematical or physical character, and B, containing those of a biological character—at intervals, so far as possible regular, and of not too great a length; no paper being kept back more than six months from the date of its publication as a separate paper.

46. In the case of communications received in the Christmas, the

Easter, or the Midsummer recess, the Secretaries shall have power, with the approval of the Chairman or Chairmen of the appropriate Sectional Committee or Committees, to issue a number or numbers of the "Proceedings" containing such communications, without waiting for their being read at a meeting of the Society.

47. When the Council or the Society has appointed a person, or two or more persons acting as Committee, to carry out a particular inquiry, and the person or Committee has presented a report giving an account of such inquiry, the Council, having consulted the appropriate Sectional Committee or Committees in the usual way as in the case of a paper presented, shall direct the report, if deemed worthy of publication, to be published either in the "Proceedings," as a separate number if this should seem convenient, or in the "Transactions," according as the one or the other may seem the more suitable for the purpose.

48. A Year-book of the Society shall be published annually, so soon after the Anniversary Meeting as shall be convenient.

Relating to the Committee of Papers.

1. The Minutes of the Council sitting as Committee of Papers shall be kept separately from the ordinary Minutes of Council.

2. At each meeting of the Committee, the Secretary shall lay before the Committee a statement of the papers under consideration, showing briefly in the case of each paper the action which has been taken in regard to it, and the recommendations which may have been made concerning it by a Sectional Committee, together with, in the case of a paper recommended for publication in the "Philosophical Transactions," an approximate estimate of the cost of publication. Such a statement, or so much of it as is possible, shall be printed and distributed to the Members of the Committee previous to the meeting.

3. At each Meeting of the Committee the written decisions of the Sectional Committees, and the reports of referees, which may have been made in respect to papers mentioned in the Statement, shall be laid upon the table.

4. The Committee may, if it see fit, adopt *en bloc* all the recommendations contained in a Statement, provided always that if any Member of the Committee, either personally or, if absent, by writing, object to any particular recommendation or recommendations, such recommendation or recommendations shall be considered separately, the remainder being treated *en bloc*.

5. The decisions of the Committee on all questions before it shall be by the majority of those present and voting, the voting being open unless any member demand a ballot, in which case the voting shall be by ballot.

EXPLANATORY NOTES ON THE PROCEDURE RELATING TO THE READING AND PUBLICATION OF PAPERS.

1. No paper is received by the Society unless it be communicated by a Fellow. A Fellow, in communicating a paper, is required by Statute to ascertain that the paper is a fit and proper one to be communicated.

A Fellow, in communicating a paper, should state whether he (or the author) desires that it should be published in the 'Proceedings' or in the 'Transactions.' In the former case, the Fellow communicating should see that the paper does not exceed in length about twelve pages of 'Proceedings,' and is not accompanied by elaborate illustrations; in the latter case, a short abstract of the main points of the communication must accompany the full paper. Since the MS. of a communication received and read, but not published by the Society, is retained in the possession of the Society,* an author is recommended not to send in the sole copy of his MS.; and it is advisable that the copy sent to the Society should be type-written, and, if possible, on a foolscap page.

It will be also convenient if, at the time of sending in the paper, the Assistant Secretary is informed what days of meeting will best suit the author for the reading, supposing it be decided that the paper should be read, and whether he wishes to be present, and whether he is prepared to illustrate the reading of the paper by experiments, projection slides, diagrams, &c. The Society cannot, however, undertake always to fix the reading of the paper on the day or even one of the days proposed by the author.

2. When a communication has been "received," the first decision taken with regard to it is whether it should be "accepted for consideration." (Standing Order 30.)

If it be not accepted for consideration, the Fellow communicating the paper is informed of this, and he may, under certain conditions, withdraw the paper. (Standing Order 31.)

3. If it be accepted, the next decision relates to the reading of the paper.

According to the nature of the paper, and according to circumstances, the reading may consist of the title only being read by one of the Secretaries, or the paper may be read in whole or in part by one of the Secretaries, or the author may be invited to give an oral exposition of the contents of his paper, with such experimental or other illustrations as he may desire.

* While retaining a MS. not ordered for publication, the Council are generally willing to return to the author drawings, &c., illustrating the paper.

A decision having been come to as to the date of the reading, this will be communicated to the author, who, according to the decision taken, will be invited to be present, and may be requested to give an oral exposition.

4. When a paper has been judged suitable for publication in the 'Proceedings,' it is without delay set up in type, so that, if possible, printed copies may be in the hands of Fellows at the meeting at which the paper is read. A proof of the paper is sent to the author with the request that he will revise the proof as carefully as possible, and return it to the Assistant Secretary as soon as possible.

It may be found desirable to set up in type and even distribute at a meeting a paper which has been marked for reading, but about the publication of which no decision has as yet been come to. Hence, receipt of the proof must not be considered by the author as an indication that the paper will certainly be published.

5. If the author, in revising the proof thus sent to him, be led to make other than verbal or unimportant corrections, or to make additions, he must, in view of the publication of the paper, carefully date all such important corrections or additions. Any such corrections or additions introduced into any subsequent revise of the paper must be similarly dated.

A paper, when published, bears on it the date of reception of the MS.; this may be used in claims of priority, and the rule just given about dating corrections and additions is intended to prevent the author claiming the date of the reception of the MS. for important statements introduced into the paper after that date.

6. An author can, if time permits, receive, on application to the Assistant Secretary, any reasonable number of copies of the proof of his paper, corrected so far as is possible, in order that if he so wishes he may send, before the meeting at which the paper is read, copies of the proof to persons likely to take part in any discussion which may follow the reading of the paper. The Society leaves to the individual author the responsibility of thus making known the results of his labours before the account of those results is formally read; so far as the Society itself is concerned, a paper communicated to it is regarded as private until it has been read.

7. When a paper has been ordered for publication in the 'Proceedings' and read, it is desirable to avoid everything which would delay its publication. Hence an author should correct the first proof of his paper so carefully that he does not need to see a second proof or revise. It will frequently, however, be found desirable for the author to see such a revise after the paper has been read. It is most important that the corrections then made should be final, and should be made without delay. A demand for still another revise, or any delay in returning that revise, is nearly

sure to prevent the paper appearing in the particular number of the 'Proceedings' which gives an account of the meeting at which the paper was read.

8. Editors of periodicals are often anxious to obtain copies of the papers read before the Society, in order that they may publish them, in whole or in part, in their own periodicals, without waiting for the appearance of the papers in the 'Proceedings' of the Society. The Society offers no objection to this practice, provided that the copy sent to the periodical is identical with the paper as it will appear in the 'Proceedings.' For this reason the Society keeps the distribution of such copies in its own hands, and does not entrust it to the authors. Otherwise, the Society would have no guarantee against the following accidents, which, indeed, previous to the present arrangements having been made, did actually occur. If it were left to the author, he might send to a periodical an early proof of a paper which, before it was ordered for publication, needed large amendment, so that the paper, as it appeared in the said periodical, might differ widely from the paper as it appeared in the 'Proceedings.' Again, since a paper ordered for reading is, for the convenience of Fellows attending the meeting at which the paper is read, usually set up in type without delay, and may be, indeed often is, so set up before it has been decided to publish the paper, it might happen (and, indeed, has happened) that an author sent to a periodical a copy of a paper as if it were about to appear in the 'Proceedings,' and yet that paper never so appeared. To avoid such undesirable occurrences, the following practice has been adopted. With the proofs of his paper the author receives a form to fill up, stating to what periodicals he wishes separate copies of his paper, *so soon as it is finally passed for press*, to be sent, and the Society distributes the copies according to the list returned. The form sent to the author contains the titles of several periodicals to which separate copies will be sent on his returning the form with his signature attached. The author can modify the list as he wishes, striking out from or adding to it.

9. When a paper is printed off for the 'Proceedings' the author is entitled to receive gratis 100 separate copies; he can have 150 additional separate copies at cost price.

10. One object of the regulations just described is to enable the Secretaries to publish as quickly as possible the papers (including abstracts) ordered for publication in the 'Proceedings,' and, save in special cases, the deliberations necessary for ordering these to be published do not take a long time.

Any decision as to publishing a paper in the 'Philosophical Transactions' necessarily takes a longer time, since the responsibility of this rests with the Sectional Committee or Committees and the Council, no such freedom of action being given to the Secretaries

and Chairmen of Committees as is given in the case of papers published in the 'Proceedings.' The author, however, may greatly help to shorten the interval between the reception of a paper and its publication in the 'Philosophical Transactions' by attending to the following matters:—

(1) The MS. should be, if possible, type-written, or at least written in a legible hand, and *properly prepared as copy for press*, so that the subsequent corrections in spelling, grammar, construction of sentences, references, &c., may be as few as possible.

(2) When the paper is accompanied by illustrations, these should be sent in *ready for reproduction*. Figures, for instance, for which a "process" can be used, should be supplied in a condition in which the process may be directly applied; figures intended to be lithographed should be properly arranged as Plates of the proper size, and so on.

(3) When the author is requested to make changes or additions to his paper before it is published, these should be made without delay; the tardy appearance of papers in the 'Philosophical Transactions' has often been due to delay of this kind on the part of the author.

PROCEDURE IN THE NOMINATION OF THE COUNCIL.*

1. The subject of the new Council shall be taken into consideration at a Meeting of Council to be held on the last Thursday of October; and with the summons for that Meeting there shall be transmitted a list of the Members of the existing Council, with the number of their attendances at Meetings up to that date; also a List of the Fellows of the Society, with an indication of those who have at any time served on the Council, and the dates of their service.

2. At this Meeting the names of those Members of the existing Council who retire at the ensuing Anniversary shall be determined. Thereafter each Member present shall hand to one of the Secretaries a List of not exceeding ten Fellows whom he proposes for the new Council, of whom five shall not have already served on the Council. Members not able to be present may send in similar lists previous to the Meeting. The several lists of names so proposed shall then be read out by the Secretary.

3. Before the next following Meeting, the President and Officers shall prepare a list of twenty-one names for consideration by the Council, which list shall include ten names selected from those proposed at the previous Meeting, or other names, if required to make

* From Minutes of Council, June 20, 1872.

up that number. The list so prepared, together with a statement of the names proposed, and the number of votes given for each, shall be sent out confidentially with the summons for the ensuing Meeting, at which Meeting the names to be finally recommended shall be balloted for. In taking the ballot, a copy of the list, prepared by the Officers, shall, with such alterations as he may see fit to make therein, be delivered by each Member of the Council present and voting, and the names found to have the majority of votes shall form the list to be recommended to the Society.

4. The President and Council shall then nominate by ballot, out of the proposed Council, the persons whom they recommend to the Society for election to the offices of President, Treasurer, Principal Secretaries, and Foreign Secretary, for the ensuing year.

PROCEDURE OF THE COUNCIL IN THE NOMINATION OF FOREIGN MEMBERS.

(*Statutes, Cap. I, §§ XIX—XXI.*)

XIX. "A book shall be kept in which Members of the Council may enter the names of those men of science whom they suggest as Foreign Members; each entry shall be signed by the proposer, and be accompanied by a short statement of the principal grounds on which the suggestion is made, and shall be valid for three years only.

XX. "When vacancies are to be filled up, a list of the persons so entered shall be sent to each member of the Council, together with notice of the Meeting at which the list will be considered. At the Meeting thus appointed further entries may be made, and the claims of those men of science whose names have been duly entered in the book shall be considered, and a selection of names shall be made, from among which the Council, at a subsequent Meeting to be then appointed, may make nominations to the Society.

XXI. "At the second Meeting the selection of the Candidates to be nominated shall be by ballot; when, if two-thirds of the Members of the Council present be in favour of the nomination of any Candidate, he shall be proposed at the next Ordinary Meeting of the Society, and shall be put to the vote at the following Ordinary Meeting."

PROCEDURE OF THE COUNCIL IN THE ADJUDICATION OF THE MEDALS.

1. At the first Meeting on the subject of the Medals, the Members of Council are invited to *suggest* a name, or names, which they may deem worthy of consideration in the adjudication of each of the several Medals. The list of suggested names then formed to be entered on the Minutes, with power to Members of Council to add to it afterwards, if they see fit.

2. At a subsequent Meeting (or Meetings), to be held before the Midsummer Recess (at which additions may be made to the List of suggestions), every Member of the Council present is at liberty to *propose* for each Medal the name of a person whom he recommends to be selected to receive it, specifying the particular work or works which form the ground of his recommendation; and these proposals, being seconded, shall be entered on the Minutes. At the same time the proposer is expected to deposit with one of the Secretaries a detailed statement of the claims of the person recommended by him, for consultation by Members of the Council, should they so desire.

3. The Council to be summoned on the last Thursday of October, for the purpose of discussing the merits, as regards the award of the Medals of the persons severally proposed. Additional proposals may be made at this Meeting, if assented to by two-thirds of the Members present.

4. The Council to meet for further consideration of the proposals on the first Thursday in November; the awards to be decided either on that day or at an early adjourned Meeting.

CONDITIONS OF AWARD OF THE ROYAL SOCIETY'S MEDALS.

The Copley Medal

is awarded to the living author of such philosophical research, either published or communicated to the Society, as may appear to the Council to be deserving of that honour. The subject or subjects of research, on account of which the medal is awarded, must be specified in making the award.

No limitation is imposed either as to the period of time within which that research was made, or to the particular country to which its author may belong.

The medal may not be awarded to any person who is a Member of the Council at the time when the award is made.

The medal may be given more than once to the same person if the Council deem it expedient.

The medal is, as far as circumstances admit, awarded annually.

The Rumford Medal,

consisting of a gold medal with a silver copy struck in the same die, is awarded once every second year "to the author of the most important discovery or useful improvement which shall be made and published by printing or in any way made known to the public in any part of Europe during the preceding two years on Heat or on Light, the preference always being given to such discoveries as, in the opinion of the President and Council of the Royal Society, tend most to promote the good of mankind.

"If during any term of years from the last award no new discovery or improvement shall have been made in any part of Europe relative to Light or Heat, in the opinion of the President and Council of sufficient importance to deserve the award, it may not be given, but the value of it may be reserved, and being laid out in the purchase of additional stock may augment the capital; and the interest of the same, by which the capital may from time to time be so augmented, may be given in money" at a subsequent award with the two medals.

The Royal Medals,

consisting each of a gold medal with a silver copy struck in the same die, are awarded annually by the Sovereign upon the recommendation of the Council, for the two most important contributions to the advancement of Natural Knowledge, published originally in Her Majesty's dominions within a period of not more than ten years, and of not less than one year of the date of the award.

In the award of the Royal Medals one is given in each year to each of the two great divisions of Natural Knowledge.

The Davy Medal

is awarded annually for the most important discovery in Chemistry made in Europe or Anglo-America.

The Darwin Medal,

which is accompanied by a grant of £100, is given biennially in reward of work of acknowledged distinction (especially in Biology) in the field in which Mr. Darwin himself laboured. The award may be made either to a British subject or a foreigner, and without distinction of sex.

THE BUCHANAN MEDAL,

which is accompanied by a grant of the balance of the Buchanan Medal Fund which may have accumulated since the last award, is awarded every five years in respect of distinguished services to Hygienic Science or Practice in the direction either of original research or of professional, administrative, or constructive work, without limit of nationality or sex.

REGULATIONS FOR ADMINISTERING THE GUNNING FUND.

A statement of the foundation will be found in the Account of the Society's Trusts, in the 'Record.' The regulations for its administration, proposed by the Council, March 14, 1895, and adopted by the Founder, May 16, 1895, are here subjoined.

REGULATIONS.

1. That the Fund should not be applied in the form of a prize, medal, or reward, but should be devoted to the furtherance of knowledge in some special direction.

2. That, by preference, the interest accruing from the Fund during every three years be applied for the promotion of Physical Science and of Biology alternately.

3. That aid should, by preference, thus be given in Physical Science and Biology respectively, either to investigations or operations which require to be repeated from time to time, or to the development of some specified continued line of research.

In illustration of Regulation 3, the Council suggested as follows:—"Among subjects that would thus seem fitting for the application of the Fund, the following might be given as instances:—The renewal from time to time of magnetic observations in the British Isles; the compilation and publication, at intervals, of detailed lists of well-authenticated spectra; systematic determination of biological data in special regions or under special conditions; assistance to naturalists or others carrying on explorations or special investigations in foreign countries; continued bacteriological observations, similar to those carried out under the direction of the Water Research Committee and others."

REGULATIONS FOR ADMINISTERING THE JOULE FUND.

(*Council Minutes, March* 14, 1895.)

1. That the proceeds be applied in the form of a Studentship or Grant, to be awarded every other year, to assist Research, especially among younger men, in those branches of Physical Science more immediately connected with Joule's work.

2. That this Grant be International in its character, and awarded alternately in Great Britain and abroad, or in such order as the President and Council shall from time to time decide.

3. That it be awarded in Great Britain by the President and Council of the Royal Society; and, for award in France, offered to the "Académie des Sciences," Paris; and in Germany, to the "K. Akademie der Wissenschaften," Berlin; or, in any other country, to the leading scientific institution, for award in that country.

4. That the award in Great Britain be made on the recommendation of a Committee, from time to time appointed by the President and Council of the Royal Society, but not of necessity confined to Fellows of the Society.

PUBLICATION FUND REGULATIONS.

The following scheme of regulations for the administration of the Publication Grant from H.M. Treasury, has been adopted by the Council:—

1. The allotment of the Grant shall be made by the President and Council.

2. In allotting the Grant, the President and Council shall consider—

(i) Applications for grants made by other Scientific Societies, such applications to be made to the Royal Society through the usual official channels

(ii) Recommendations made by the Sectional Committees or Referees in respect of papers presented to the Society and submitted to them for consideration.

(iii) Proposals made by Members of the Council.

3. The President and Council, while primarily aiding by grants the publication of papers which, though thought worthy of being published, are not considered suitable for publication by the Royal Society, shall not in any way be precluded from making allotments in aid of the publications of the Society.

4. Original memoirs shall be considered as having first claim on the Grant, the aid being given towards the expense either of illustra-

tions or of press-work; but the President and Council shall have power, if they see fit, to make a grant in aid of other publications which tend to the advancement of natural knowledge, such as reports, abstracts, &c.

5. No decision of the President and Council at any one meeting of the Council, to allot a portion of the Grant, shall be valid unless it receives the support of three-fourth of the members present and voting; but the decision of a simple majority at any one meeting shall be made valid if confirmed by the majority at a subsequent meeting.

REGULATIONS FOR ADMINISTERING THE SCIENTIFIC RELIEF FUND.*

The history of the Scientific Relief Fund will be found in the account of the Society's Trusts contained in the "Record." The following are the Regulations at present in force:—

Regulations.

1. There shall be a fund called The Scientific Relief Fund, and the object of it shall be to aid such scientific men, or their families, as may from time to time require assistance.
2. All contributions to the fund shall be invested in the name of the Royal Society in such funds as are authorised for investment by Trustees; and in such manner as to form a separate account from that of the Society's other funded property.
3. The fund shall be administered by a Committee, called The Scientific Relief Committee, which shall consist of ten Fellows of the Royal Society, and it shall be the duty of such Committee to select the recipients on whose behalf the income derived from the fund may be properly applied—always reporting thereon to the Council for confirmation.
4. The capital of the Fund shall remain entire, and the interest only shall be at the disposal of the Committee.
5. If the whole of the interest shall not be expended in one year, the surplus shall be carried to the next year's account; and, if at any time any surplus in excess of the ordinary income of the year last past shall thus accrue, the Council shall cause the whole, or part of it, to be added to the capital sum already invested; or, should they think fit, may cause any accumulated

* Mainly codified from the Original Regulations adopted by the Council Nov. 3, 1895 (see also Minutes of May 26, 1859), and subsequent modifications passed by the Council on Dec. 22, 1859, Jan. 18, 1866, April 30, 1891, Jan. 19, 1893, April 30, 1896, Nov. 5, 1896.

interest to be invested as unexpended income, the securities purchased being liable from time to time to be realised, and the proceeds expended as income.

6. No application for relief shall be entertained except on the recommendation of the President of one of the following Scientific Societies:—The Chemical, Entomological, Geological, Linnean, London Mathematical, Physical, Royal, Royal Astronomical, Royal Geographical, Royal Meteorological, Royal Irish Academy, Royal Society of Edinburgh, Society of Antiquaries, or Zoological Society; it being understood that the several Presidents will consult their respective Councils as to the persons whom they intend to recommend for relief.
7. The members of the Committee shall be appointed by the Council, and shall consist of ten members, each of whom shall serve for five years, so that two retire annually, and be not eligible for re-appointment on the occasion of their retiring. Should a vacancy occur by reason of death or otherwise, at any intermediate time, the Council shall appoint a person to fill the vacancy, and the person so appointed shall retire at the time the member whose place he fills would have retired had he continued until then to be a member, but if he have not served more than two years shall be eligible for re-appointment.
8. The Council shall annually appoint a member of the Committee to act as Chairman for the ensuing year. The Chairman shall have power to nominate one of the Committee to act as his deputy.
9. The Chairman, or his deputy, shall have power to summon a meeting of the Committee at his discretion, and shall fix the time of such meeting.
10. Three of the Committee shall form a quorum.
11. The Treasurer of the Society shall have power, on the requisition of the Chairman of the Committee, or of his deputy, made in pursuance of a resolution of the Committee, but subject, nevertheless, to the provisions of Regulation 12, to make payments out of the Scientific Relief Fund not exceeding £100 in any one case, reporting such action to the Council at its next meeting.
12. The Chairman, or his deputy, shall, notwithstanding Regulation 6, have power to act in urgent cases during vacations of the Society, after consultation with one of the Secretaries of the Society, without calling the Committee together. In such cases the Chairman shall, after the vacation, summon a meeting of the Committee and report his action.

In the first Report of the Committee, dated November 30, 1864, it is stated that "It formed no part of the scheme to attempt the grant of annuities; it was rather intended to afford *prompt* relief of

the immediate wants of those upon whom sudden affliction had fallen; although at the same time, it in no way debarred a continuation of such relief being given should the funds admit thereof." This intention of the founders, although it has not been embodied in a Regulation, has been continued, as a policy, to the present time.

Applicants are desired to fill in a form which can be obtained from the Assistant Secretary of the Royal Society, in which (confidential) information is requested upon the following points:—

1. Name, Age, and Social Condition.
2. Nature of Claims, stating scientific work done by the subject of the proposed grant, or by the member of his family on whose scientific claim he relies, appending a list of his principal contributions to science.
3. The nature of the emergency, and how it has arisen.
4. Whether the applicant is receiving, or has received, during the past six months, pecuniary aid from any other source.
5. Whether the applicant is entitled or able, in the circumstances which have arisen, to look to any other assistance; and, if so, what is the source and extent of such expected assistance.
6. Particulars of—

    Number in family.
    How many are self-supporting.
    How many are partially dependent.
    How many are wholly dependent.

In 1886 Sir William (now Lord) Armstrong gave a sum of £7,800 to the Scientific Relief Fund, on the understanding that the said fund should be used for remission of fees in cases of urgent necessity. By a Resolution of Council passed December 10, 1889, "the question of the remission of fees to Fellows of the Society in impecunious circumstances is reserved for the sole consideration of the President and Council of the Society, the amount thus from time to time bestowed being communicated to the Scientific Relief Committee."

REGULATIONS FOR ADMINISTERING THE GOVERNMENT GRANT FOR SCIENTIFIC INVESTIGATIONS.

I.

1. The Government Grant shall be administered by a General Committee, consisting of the President and Council of the Royal Society for the time being, of the following *ex officio* Members:—

    The President of the Royal Society of Edinburgh and one other Representative,

The President of the Royal Irish Academy and one other Representative,

The Presidents of—

The British Association,
The London Mathematical Society,
The Royal Astronomical Society,
The Physical Society,
The Institution of Civil Engineers,
The Institution of Mechanical Engineers,
The Institution of Electrical Engineers,
The Chemical Society,
The Iron and Steel Institute,
The Geological Society,
The Royal Geographical Society,
The Linnean Society,
The Zoological Society,
The Anthropological Institute,
The Royal College of Physicians,
The Royal College of Surgeons,

and of the Members, for the time being, of the several Boards hereinafter spoken of.

2. Seven Boards shall be established, viz.:—

A. For the consideration of Applications relating to Mathematics, Mathematical Physics, Crystallography, and Mathematical Astronomy.

B. For the consideration of Applications relating to Experimental Physics, Observational Astronomy, and Meteorology.

C. For the consideration of Applications relating to Chemistry and Metallurgy.

D. For the consideration of Applications relating to Geology, Palæontology, Mineralogy, and Geography.

E. For the consideration of Applications relating to Botany.

F. For the consideration of Applications relating to Zoology and Comparative Anatomy.

G. For the consideration of Applications relating to (Animal) Physiology and Medical Subjects.

3. Each Board shall consist of eight members, to be appointed by the President and Council of the Royal Society, Scotland and Ireland being as far as possible represented on each Board, and each member shall serve for four years, so that two retire annually, and be not eligible for re-appointment on the occasion of their retiring. Should a vacancy occur by reason of death or otherwise, at any intermediate time, the Council shall appoint a person to fill the vacancy, and the

person so appointed shall retire at the time the member whose place he fills would have retired had he continued until then to be a member, but if he have not served more than two years shall be eligible for re-appointment.

4. The President and Council of the Royal Society shall appoint a member of each Board to be Chairman of the Board. All communications made to and by the Board shall be made through the Chairman, who shall be held responsible for the management of the business of the Board, and who shall have a second or casting vote. When a Chairman is unable to perform the duties of the Chair, he shall appoint a member of the Board to act as his deputy, and to exercise his powers.

II.

5. In order to meet any extraordinary demands which may be made upon the Grant, a Reserve Fund shall be gradually accumulated, but so that it shall not at any time exceed £2,000.

6. A Grant, the payment of which is intended to be completed within the twelvemonth following upon the meeting of the Committee at which the Grant was made, shall be called an "ordinary" Grant. The Committee shall, however, if they see fit, make Grants for "personal" or other expenditure, each of which may extend over a period not exceeding three years, but in no case shall such a personal Grant exceed £300 per annum. For this purpose the Committee may, in any one year, reserve from the Fund of the year an amount sufficient to cover the payments during the period for which the Grant has been made, the continuance of the payment of the instalments of such Grants to be conditional on the recipients furnishing, as hereinafter provided, evidence satisfactory to the Committee that the object of the Grant is being properly carried out. Such Grants shall be called "extended" Grants.

III.

7. Adequate notice shall be given in the public papers each year that applications for Grants must be sent in to the Royal Society not later than the last day of January, and no applications received after that date shall be considered by the Committee of that year.

8. Each applicant shall be required to furnish information under the following heads:—

a. The nature of the research in which he desires to engage, and of the scientific results expected to follow therefrom.

b. The amount asked for.

c. Whether he has received any previous Grant from any source for the same object, and if so, with what results.

d. Whether any portion of the Grant is to be devoted to his own personal expenses.

e. What apparatus, if any, of permanent value he will require; so that any instruments, already at the disposal of the Committee, may be utilised.

9. As soon as possible after February 1st in each year, the Secretaries of the Royal Society shall cause to be drawn up a list of all the applications, arranged, according to the nature of the research in each application, in classes corresponding to the above-mentioned Boards, and shall cause such list to be distributed to all Members of the Committee. This list shall contain a brief statement of the information received under Clause 8.

10. The Secretaries of the Royal Society shall further cause to be sent to the Chairman of each Board a list of the applications belonging to the class corresponding to his Board, together with any other information, letters, documents, &c., which may have been furnished by the several applicants.

11. Each Board, having taken into consideration the applications submitted to it, making such use of correspondence between Members of the Board as may be desirable for the purpose, shall send to the Secretaries of the Royal Society, some day in May to be determined each year by the President and Council of the Royal Society, a written Report, stating, with reference to each such application, whether they recommend the acceptance of it in part or in whole, or the rejection of it; and the Secretaries of the Royal Society shall cause the Reports of the several Boards to be distributed as soon as possible to all Members of the Committee.

12. Should any application appear to the Secretaries of the Royal Society to relate to more than one Board, they shall, with the approval of the President of the Royal Society, refer the application to the several Boards to which it appears to relate. In such cases the Chairman of one of the Boards concerned shall, on the nomination of the President of the Royal Society, be requested to take charge of the application, to be responsible for its being laid before the Boards concerned, and to present the Report of those Boards on the application at the same time that he presents the usual Report of his own Board.

13. It shall be in the power of any Board to initiate an inquiry and to recommend a Grant for the purpose, and such a recommendation having been reported to the Committee with the other recommendations of the Board, shall take its place among applications recommended to the Committee for acceptance, in spite of application not having been made in the ordinary way.

14. The Committee shall meet on the third Wednesday (or, if that fall in Whitsun Week, the fourth Wednesday) in May, at which

meeting the Reports of the Boards shall be read, considered (the Chairman of each Board, or in his place some other Member of it, giving such explanations with regard to the decisions of the Board as may seem desirable), and voted upon. The voting shall be by show of hands, unless any Member demands a ballot, in which case it shall be by ballot.

15. In the case of applications which have been recommended by the appropriate Board, or recommendations initiated by any Board, the voting in Committee shall be by simple majority of those present, except in the case of "extended" Grants coming under Clause 6, which Grants shall require the assent of two-thirds of those present.

16. Applications which have been rejected by the appropriate Board shall not be reconsidered in Committee except with the consent of two-thirds of those present, and any applications so reconsidered shall not be granted by the Committee otherwise than by a majority of two-thirds; likewise a proposal to increase the amount of any Grant recommended by a Board shall not be considered in Committee except with the consent of two-thirds of those present, and the increase so considered shall not be granted by the Committee otherwise than by a majority of two-thirds.

17. The Committee shall have power to place each year at the disposal of the President and Council of the Royal Society, a sum not exceeding £500 to meet any pressing demands upon the Fund which may be made between the annual meetings of the Committee.

18. The President of the Royal Society shall further have power, in case he is of opinion that there is urgency for an immediate Grant of a sum too large to be provided by the Fund referred to in 17, and necessitating a call upon the Reserve Fund, to summon a Special Meeting of the Committee, who, if they see fit, shall decide on such Grant, provided always that due notice of such meeting, with a statement of the purpose for which it is called, be sent to each Member of Committee fifteen days before the date fixed for the meeting.

IV.

19. All Grants shall be subject to the following conditions, and every applicant shall, on his applying, be duly informed of these conditions:—

i. That all instruments, specimens, objects, or materials of permanent value, whether purchased or obtained out of, or by means of, the Grant, or supplied from among those at the disposal of the Committee, are to be regarded, unless the Committee decide otherwise, as the property of the Government, and are to be returned by the applicant, for disposal

according to the orders of the Committee, at the conclusion of his Research, or at such other time as the Committee may determine.

ii. That every one receiving a Grant shall furnish to the Committee, on or before the 31st of January following upon the allotment of the Grant, a Report (or, if the object of the Grant be not then attained, an interim Report, to be renewed at the same date in each subsequent year until a final Report can be furnished), containing (*a*) a brief statement showing the results arrived at, or the stage which the inquiry has reached; (*b*) a general statement of the expenditure incurred, accompanied, so far as is possible, by vouchers; (*c*) a list of the instruments, specimens, objects or materials, purchased or obtained out of the Grant, or supplied by the Committee, which are at present in his possession; and (*d*) references to any Transactions, Journals, or other publications in which results of the Research have been printed.

iii. That Grants shall lapse at the end of two years from the date of allotment, if application for payment be not made within that time.

The Committee shall further have power to attach to any Grant any other conditions which they may think desirable.

20. Every applicant to whom a Grant is made shall, before any of the Grant is paid to him, be required to sign an engagement (which may be incorporated in the receipt for the money) that he is prepared to carry out the general conditions applicable to all Grants, as well as any conditions which may be attached to his particular Grant.

21. Printed copies of the Reports, provided for by Regulation 19, § ii, shall each year, so soon as possible after January 31, be submitted to the several Boards; and it shall be the duty of each Board to examine the Reports relating to Grants recommended by it, and to report to the Committee (or, in case of urgency, to the Council of the Royal Society) any deficiencies therein, or any action relating thereto which the Board thinks desirable.

22. In the case of a Grant recommended by a Board being for the purpose of enabling the applicant to collect by means of the Grant, or of part of it, specimens, objects, or materials of permanent value, the Board shall, whenever it is able to do so, add to its recommendation conditions as to the final disposal of such specimens, objects, or materials.

23. When an application is for a Grant to two or more persons to act as a Committee for the purpose of carrying out some scientific object, the application shall state which Member of the proposed

Committee is willing to act as Secretary, to be responsible for furnishing the Report, for receiving and disbursing the money, and in general for the conduct of the business of the Committee.

24. The recipient of an "extended" Grant shall make to the Board which recommended the Grant, half-yearly, or, if the Board desire it, oftener, such Reports as the Board may determine concerning the way in which the object of the Grant is being carried out; and each such recipient shall, on receiving notice that the Grant has been made to him, be informed of his duty to make such Reports, and shall express in writing his willingness to do so. Should any Board be of opinion, after receiving such Reports, that the object of the Grant is not being properly carried out, they shall report the same to the next meeting of the Committee. The Chairman of the Board shall move at the meeting of the Committee that the Grant be discontinued, and if the Committee by a majority approve of the Grant being discontinued, it shall be discontinued.

V.

25. The duties of Clerk to the Committee and other business incidental thereto may be performed by the staff of the Royal Society; and the sum of £120 shall be yearly placed at the disposal of the Council for salaries and incidental purposes.

26. A Schedule shall be kept of all instruments, specimens, &c., of permanent value, in furtherance of Regulation 19, and of Clause *e* of Regulation 8.

APPENDIX TO THE GOVERNMENT GRANT REGULATIONS.

I.

INSTRUCTIONS FOR THE GOVERNMENT GRANT BOARDS.

(*Minutes of Council, March* 15, 1894.)

1. Each Chairman has authority to summon his Board, whenever he thinks fit (in addition to any Meeting or Meetings of the Board which may be appointed by the Council), to meet either at the Rooms of the Royal Society, during the hours specified in the Statutes (chap. xiv, § 7), or at such other place as he may deem desirable.

2. The summonses are to be issued by the Clerk at the direction of the Chairman.

3. Any four members of a Board are to be a quorum of that Board;

but the decisions arrived at at a Meeting of a Board at which less than four members are present shall be valid, if subsequently agreed to in writing by not less than five members in all.

4. It is desirable that each year a Meeting of each Board should be held at the Society's Rooms soon after the receipt by the Chairman of the applications, and that another Meeting to come to final decisions on the applications should be held, also at the Society's Rooms, on the day fixed by the Council; but the Chairman may, if he finds it desirable, change the day of the latter Meeting, and he may even omit the one or the other of these Meetings, should he judge the one or the other to be unnecessary.

5. If the Chairman of a Board, on receiving a list of applications under Regulation 10, shall find that any application on that list is, in his opinion, more appropriate to another Board than his own, or that any application which ought, from its nature, to have been referred to a Board or to Boards besides his own, is referred only to his own Board, or that an application proper to his Board has been referred to another Board, he shall at once report the same to the Secretaries of the Royal Society.

6. The Chairman of a Board may authorise the transfer of any instrument, specimen, &c., obtained by means of a Government Grant, and no longer needed by the person by whom it was obtained or to whom it was assigned, to any other person applying to the Government Grant Committee for the loan of the instrument, specimen, &c., if in his judgment such a transfer is desirable. He shall in each case report his having done so to the Secretaries of the Royal Society.

II.

INSTRUCTIONS FOR A COMMITTEE APPOINTED FOR THE PURPOSE OF ADMINISTERING A GRANT UNDER SECTION 23 OF THE GOVERNMENT GRANT REGULATIONS.

(*Minutes of Council, February* 22, 1895.)

1. The Secretary of the Committee has authority to call a Meeting of the Committee whenever he thinks desirable, either at the Rooms of the Royal Society, during the hours specified in the Statutes (chap. xiv, § 7), or at such other place as he may deem desirable.

2. The summons for each such Meeting shall be issued by the Clerk, from the Society's Apartments.

3. To constitute a quorum, at any meeting of the Committee, at least one-half of the Members of the Committee, the Secretary being one, must be present.

4. The provisions of Regulation 19 apply in all particulars to a Committee as well as to an individual applicant, and every Com-

mittee receiving a Grant is to continue (subject to any decision to the contrary by the Council of the Royal Society, or by the General Committee) until such time as the final Report upon their research has been furnished.

5. When a Committee is re-appointed, with or without change as to the persons composing it, for continuing a research, and receives a new Grant, it is to be considered a new Committee for all purposes of expenditure and reporting, and is in no way responsible for expenses incurred by its predecessor.

The above instructions are intended only for the cases in which a Committee is especially constituted in order to receive a Grant. Grants may be made to already existing Committees established independently of any application for a Grant. In such cases the above instructions are not intended to apply, and the procedure of meetings, constitution of quorum, &c., of such a Committee must be determined in each case by the Committee itself. In all such latter cases the Chairman or Secretary of the Committee, or some other person, must be authorised by the Committee to be the responsible representative of the Committee in question before the Government Grant Committee, to make application to receive moneys, to furnish reports, &c., &c.

March 25, 1896.

GOVERNMENT GRANT BOARDS, 1898.

Board A.

Chairman—Major MacMahon.

	Retire March 1st.
**Prof. Lamb, Prof. C. Niven*	*1898*
Prof. G. H. Darwin, Major MacMahon	1899
Prof. Elliott, Dr. Hobson	1900
Professor Chrystal, Dr. Larmor	1901
Prof. Forsyth, Prof. Greenhill	1902

Board B.

Chairman—Prof. Unwin.

Prof. Lodge, Prof. Reinold	*1898*
Mr. R. T. Glazebrook, Prof. Unwin	1899
Mr. C. V. Boys, Sir W. Huggins	1900
Capt. Abney, Prof. Fitzgerald	1901
Mr. S. Bidwell, Lord Kelvin	1902

* Members whose names are in italics serve only *until* March 1, 1898. The two members named last on each Board serve only *from* March 1, 1898.

BOARD C.

Chairman—Dr. Thorpe.

	Retire March 1st.
Prof. McLeod, Prof. Meldola	*1898*
Prof. Dixon, Prof. Tilden	1899
Prof. Armstrong, Prof. J. E. Reynolds	1900
Prof. Crum Brown, Dr. Thorpe	1901
Prof. Dunstan, Prof. Roberts-Austen	1902

BOARD D.

Chairman—Dr. Blanford.

Prof. Maskelyne, Prof. Seeley	*1898*
Prof. J. Geikie, Prof. McKenny Hughes	1899
Dr. H. Hicks, Prof. Sollas	1900
Dr. Blanford, Mr. Teall	1901
Prof. Judd, Prof. Dawkins	1902

BOARD E.

Chairman—Mr. C. B. Clarke.

Mr. F. Darwin, Mr. W. Carruthers	*1898*
Mr. H. T. Brown, Mr. C. B. Clarke	1899
Prof. Balfour, Dr. D. H. Scott	1900
Prof. J. R. Green, Prof. Vines	1901
Mr. Gardiner, Prof. Oliver	1902

BOARD F.

Chairman—Mr. Godman.

Prof. McIntosh, Mr. O. Salvin	*1898*
Prof. Lankester, Prof. Haddon	1899
Mr. Beddard, Prof. Herdman	1900
Prof. Hickson, Prof. Macalister	1901
Mr. Godman, Prof. J. C. Ewart	1902

BOARD G.

Chairman—Dr. Gaskell.

Dr. Brunton, Prof. Gotch	*1898*
Prof. Purser, Prof. Sanderson	1899
Dr. Gaskell, Prof. Halliburton	1900
Prof. McKendrick, Prof. Sherrington	1901
Prof. W. Watson Cheyne, Dr. Waller	1902

INSTITUTIONS

ENTITLED

TO RECEIVE THE PHILOSOPHICAL TRANSACTIONS OR PROCEEDINGS OF THE ROYAL SOCIETY.

Institutions marked A are entitled to receive Philosophical Transactions, Series A, and Proceedings.
Institutions marked B are entitled to receive Philosophical Transactions, Series B, and Proceedings.
Institutions marked AB are entitled to receive Philosophical Transactions, Series A and B, and Proceedings.
Institutions marked *p* are entitled to receive Proceedings only.

America (Central).

Mexico.

p. Sociedad Científica "Antonio Alzate."

America (North). (See UNITED STATES and CANADA.)

America (South).

Buenos Ayres.

AB. Museo Nacional.

Caracas.

B. University Library.

Cordova.

AB. Academia Nacional de Ciencias.

Demerara.

p. Royal Agricultural and Commercial Society, British Guiana.

La Plata.

B. Museo de la Plata.

Rio de la Janeiro.

p. Observatorio.

Australia.

Adelaide.

p. Royal Society of South Australia.

Brisbane.

p. Royal Society of Queensland.

Australia—*continued.*

Melbourne.

p. Observatory.
p. Royal Society of Victoria.
AB. University Library.

Sydney.

p. Australian Museum.
p. Geological Survey.
p. Linnean Society of New South Wales.
AB. Royal Society of New South Wales.
AB. University Library.

Austria.

Agram.

p. Jugoslavenska Akademija Znanosti i Umjetnosti.
p. Societas Historico-Naturalis Croatica.

Brünn.

AB. Naturforschender Verein.

Gratz.

AB. Naturwissenschaftlicher Verein für Steiermark.

Innsbruck.

AB. Das Ferdinandeum.
p. Naturwissenschaftlich-Medicinischer Verein.

Prague.

AB. Königliche Böhmische Gesellschaft der Wissenschaften.

Trieste.

B. Museo di Storia Naturale.
p. Società Adriatica di Scienze Naturali.

Vienna.

p. Anthropologische Gesellschaft.
AB. Kaiserliche Akademie der Wissenschaften.
p. K.K. Geographische Gesellschaft.
AB. K.K. Geologische Reichsanstalt.
B. K.K. Naturhistorisches Hof-Museum.
B. K.K. Zoologisch-Botanische Gesellschaft.
p. Oesterreichische Gesellschaft für Meteorologie.
A. Von Kuffner'sche Sternwarte.

Belgium.

Brussels.

B. Académie Royale de Médecine.
AB. Académie Royale des Sciences.
B. Musée Royal d'Histoire Naturelle de Belgique.
p. Observatoire Royal.
p. Société Belge de Géologie, de Paléontologie, et d'Hydrologie.
p. Société Malacologique de Belgique.

Belgium—*continued.*

Ghent.

AB. University.

Liége.

AB. Société des Sciences.

p. Société Géologique de Belgique.

Louvain.

B. Laboratoire de Microscopie et de Biologie Cellulaire.

AB. Université.

Canada.

Hamilton.

p. Hamilton Association.

Montreal.

AB. McGill University.

p. Natural History Society.

Ottawa.

AB. Geological Survey of Canada.

AB. Royal Society of Canada.

Toronto.

p. Astronomical and Physical Society.

p. Canadian Institute.

AB. University.

Cape of Good Hope.

A. Observatory.

AB. South African Library.

Ceylon.

Colombo.

B. Museum.

China.

Shanghai.

p. China Branch of the Royal Asiatic Society.

Denmark.

Copenhagen.

AB. Kongelige Danske Videnskabernes Selskab.

Egypt.

Alexandria.

AB. Bibliothèque Municipale.

England and Wales.

Aberystwith.

AB. University College.

Bangor.

AB. University College of North Wales.

Birmingham.

AB. Free Central Library.

England and Wales—*continued.*

AB. Mason College.
p. Philosophical Society.

Bolton.
p. Public Library.

Bristol.
p. Merchant Venturers' School.
AB. University College.

Cambridge.
AB. Philosophical Society.
p. Union Society.

Cooper's Hill.
AB. Royal Indian Engineering College.

Dudley
p. Dudley and Midland Geological and Scientific Society.

Essex.
p. Essex Field Club.

Falmouth.
p. Royal Cornwall Polytechnic Society.

Greenwich.
A. Royal Observatory.

Kew.
B. Royal Gardens.

Leeds.
p. Philosophical Society.
AB. Yorkshire College.

Liverpool.
AB. Free Public Library.
p. Literary and Philosophical Society.
A. Observatory.
AB. University College.

London.
AB. Admiralty.
p. Anthropological Institute.
AB. British Museum (Nat. Hist.).
AB. Chemical Society.
A. City and Guilds of London Institute.
p. "Electrician," Editor of the.
B. Entomological Society.
AB Geological Society.
AB. Geological Survey of Great Britain.
p. Geologists' Association.
AB. Guildhall Library.
A. Institution of Civil Engineers.
p. Institution of Electrical Engineers.

England and Wales—*continued.*

A. Institution of Mechanical Engineers.
A. Institution of Naval Architects.
p. Iron and Steel Institute.
AB. King's College.
B. Linnean Society.
AB. London Institution.
p. London Library.
A. Mathematical Society.
p. Meteorological Office.
p. Odontological Society.
p. Pharmaceutical Society.
p. Physical Society.
p. Quekett Microscopical Club.
p. Royal Agricultural Society.
p. Royal Asiatic Society.
A. Royal Astronomical Society.
B. Royal College of Physicians.
B. Royal College of Surgeons.
p. Royal Engineers (for Libraries abroad, six copies).
AB. Royal Engineers. Head Quarters Library.
p. Royal Geographical Society.
p. Royal Horticultural Society.
p. Royal Institute of British Architects.
AB. Royal Institution of Great Britain.
B. Royal Medical and Chirurgical Society.
p. Royal Meteorological Society.
p. Royal Microscopical Society.
p. Royal Statistical Society.
AB. Royal United Service Institution.
AB. Society of Arts.
p. Society of Biblical Archæology.
p. Society of Chemical Industry (London Section).
p. Standard Weights and Measures Department.
AB. The Queen's Library.
AB. The War Office.
AB. University College.
p. Victoria Institute.
B. Zoological Society.

Manchester.

AB. Free Library.
AB. Literary and Philosophical Society.
p. Geological Society.
AB. Owens College.

England and Wales—*continued.*

Netley.
p. Royal Victoria Hospital.

Newcastle.
AB. Free Library.
p. North of England Institute of Mining and Mechanical Engineers.
p. Society of Chemical Industry (Newcastle Section).

Norwich.
p. Norfolk and Norwich Literary Institution.

Nottingham.
AB. Free Public Library.

Oxford.
p. Ashmolean Society.
AB. Radcliffe Library.
A. Radcliffe Observatory.

Penzance.
p. Geological Society of Cornwall.

Plymouth.
B. Marine Biological Association.
p. Plymouth Institution.

Richmond.
A. "Kew" Observatory.

Salford.
p. Royal Museum and Library.

Stonyhurst.
p. The College.

Swansea.
AB. Royal Institution.

Woolwich.
AB. Royal Artillery Library.

Finland.

Helsingfors.
p. Societas pro Fauna et Flora Fennica.
AB. Société des Sciences.

France.

Bordeaux.
p. Académie des Sciences.
p. Faculté des Sciences.
p. Société de Médecine et de Chirurgie.
p. Société des Sciences Physiques et Naturelles.

Caen.
Société Linnéenne de Normandie.

France—*continued.*

Cherbourg.
- *p.* Société des Sciences Naturelles.

Dijon.
- *p.* Académie des Sciences.

Lille.
- *p.* Faculté des Sciences.

Lyons.
- AB. Académie des Sciences, Belles-Lettres et Arts.
- AB. Université.

Marseilles.
- AB. Faculté des Sciences.

Montpellier.
- AB. Académie des Sciences et Lettres.
- B. Faculté de Médecine.

Nantes.
- *p.* Société des Sciences Naturelles de l'Ouest de la France.

Paris.
- AB. Académie des Sciences de l'Institut.
- *p.* Association Française pour l'Avancement des Sciences.
- *p.* Bureau des Longitudes.
- A. Bureau International des Poids et Mesures.
- *p.* Commission des Annales des Ponts et Chaussées.
- *p.* Conservatoire des Arts et Métiers.
- *p.* Cosmos (M. L'ABBÉ VALETTE).
- AB. Dépôt de la Marine.
- AB. École des Mines.
- AB. École Normale Supérieure.
- AB. École Polytechnique.
- AB. Faculté des Sciences de la Sorbonne.
- AB. Jardin des Plantes.
- *p.* L'Électricien.
- A. L'Observatoire.
- *p.* Revue Scientifique (Mons. H. DE VARIGNY).
- *p.* Société de Biologie.
- AB. Société d'Encouragement pour l'Industrie Nationale.
- AB. Société de Géographie.
- *p.* Société de Physique.
- B. Société Entomologique.
- AB. Société Géologique.
- *p.* Société Mathématique.
- *p.* Société Météorologique de France.

Toulouse.
- AB. Académie des Sciences.
- A. Faculté des Sciences.

Germany.

Berlin.
- A. Deutsche Chemische Gesellschaft.
- A. Die Sternwarte.
- *p.* Gesellschaft für Erdkunde.
- AB. Königliche Preussische Akademie der Wissenschaften.
- A. Physikalische Gesellschaft.

Bonn.
- AB. Universität.

Bremen.
- *p.* Naturwissenschaftlicher Verein.

Breslau.
- *p.* Schlesische Gesellschaft für Vaterländische Kultur.

Brunswick.
- *p.* Verein für Naturwissenschaft.

Carlsruhe. See Karlsruhe.

Charlottenburg.
- A. Physikalisch-Technische Reichsanstalt.

Danzig.
- AB. Naturforschende Gesellschaft.

Dresden.
- *p.* Verein für Erdkunde.

Emden.
- *p.* Naturforschende Gesellschaft.

Erlangen.
- AB. Physikalisch-Medicinische Societät.

Frankfurt-am-Main.
- AB. Senckenbergische Naturforschende Gesellschaft.
- *p.* Zoologische Gesellschaft.

Frankfurt-am-Oder.
- *p.* Naturwissenschaftlicher Verein.

Freiburg-im-Breisgau.
- AB. Universität.

Giessen.
- AB. Grossherzogliche Universität.

Görlitz.
- *p.* Naturforschende Gesellschaft.

Göttingen.
- AB. Königliche Gesellschaft der Wissenschaften.

Halle.
- AB. Kaiserliche Leopoldino-Carolinische Deutsche Akademie der Naturforscher.
- *p.* Naturwissenschaftlicher Verein für Sachsen und Thüringen.

Germany—*continued.*

Hamburg.
- *p.* Naturhistorisches Museum.
- AB. Naturwissenschaftlicher Verein.

Heidelberg.
- *p.* Naturhistorisch-Medizinischer Verein.
- AB. Universität.

Jena.
- AB. Medicinisch-Naturwissenschaftliche Gesellschaft.

Karlsruhe.
- A. Grossherzogliche Sternwarte.
- *p.* Technische Hochschule.

Kiel.
- *p.* Naturwissenschaftlicher Verein für Schleswig-Holstein.
- A. Sternwarte.
- AB. Universität.

Königsberg.
- AB. Königliche Physikalisch-Ökonomische Gesellschaft.

Leipsic.
- *p.* Annalen der Physik und Chemie.
- AB. Königliche Sächsische Gesellschaft der Wissenschaften.

Magdeburg.
- *p.* Naturwissenschaftlicher Verein.

Marburg.
- AB. Universität.

Munich.
- AB. Königliche Bayerische Akademie der Wissenschaften.
- *p.* Zeitschrift für Biologie.

Münster.
- AB. Königliche Theologische und Philosophische Akademie.

Potsdam.
- A. Astrophysikalisches Observatorium.

Rostock.
- AB. Universität.

Strasburg.
- AB. Universität.

Tübingen.
- AB. Universität.

Würzburg.
- AB. Physikalisch-Medicinische Gesellschaft.

Greece.

Athens.
- A. National Observatory.

Holland. (See NETHERLANDS.)

Hungary.

Buda-pest.

p. Königl. Ungarische Geologische Anstalt.

AB. Á Magyar Tudós Társaság. Die Ungarische Akademie der Wissenschaften.

Hermannstadt.

p. Siebenbürgischer Verein für die Naturwissenschaften.

Klausenburg.

AB. Az Erdélyi Muzeum. Das Siebenbürgische Museum.

Schemnitz.

p. K. Ungarische Berg- und Forst-Akademie.

India.

Bombay.

AB. Elphinstone College.

p. Royal Asiatic Society (Bombay Branch).

Calcutta.

AB. Asiatic Society of Bengal.

AB. Geological Museum.

p. Great Trigonometrical Survey of India.

AB. Indian Museum.

p. The Meteorological Reporter to the Government of India,

Madras.

B. Central Museum.

A. Observatory.

Roorkee.

p. Roorkee College.

Ireland.

Armagh.

A. Observatory.

Belfast.

AB. Queen's College.

Cork.

p. Philosophical Society.

AB. Queen's College.

Dublin.

A. Observatory.

AB. National Library of Ireland.

B. Royal College of Surgeons in Ireland.

AB. Royal Dublin Society.

AB. Royal Irish Academy.

Galway.

AB. Queen's College.

Italy.

Acireale.

p. Accademia di Scienze, Lettere ed Arti.

Italy—*continued.*

Bologna.
- AB. Accademia delle Scienze dell' Istituto.

Catania.
- AB. Accademia Gioenia di Scienze Naturali.

Florence.
- *p.* Biblioteca Nazionale Centrale.
- AB. Museo Botanico.
- *p.* Reale Istituto di Studi Superiori.

Genoa.
- *p.* Società Ligustica di Scienze Naturali e Geografiche.

Milan.
- AB. Reale Istituto Lombardo di Scienze, Lettere ed Arti.
- AB. Società Italiana di Scienze Naturali.

Modena.
- *p.* Le Stazioni Sperimentali Agrarie Italiane.

Naples.
- *p.* Società di Naturalisti.
- AB. Società Reale, Accademia delle Scienze.
- B. Stazione Zoologica (Dr. DOHRN).

Padua.
- *p.* University.

Palermo.
- A. Circolo Matematico.
- AB. Consiglio di Perfezionamento (Società di Scienze Naturali ed Economiche).
- A. Reale Osservatorio.

Pisa.
- *p.* Il Nuovo Cimento.
- *p.* Società Toscana di Scienze Naturali.

Rome.
- *p.* Accademia Pontificia de' Nuovi Lincei.
- *p.* Rassegna delle Scienze Geologiche in Italia.
- A. Reale Ufficio Centrale di Meteorologia e di Geodinamica, Collegio Romano.
- AB. Reale Accademia dei Lincei.
- *p.* R. Comitato Geologico d' Italia.
- A. Specola Vaticana.
- AB. Società Italiana delle Scienze.

Siena.
- *p.* Reale Accademia dei Fisiocritici.

Turin.
- *p.* Laboratorio di Fisiologia.
- AB. Reale Accademia delle Scienze.

Italy—*continued.*

Venice.

p. Ateneo Veneto.

AB. Reale Istituto Veneto di Scienze, Lettere ed Arti.

Japan.

Tokiô.

AB. Imperial University.

p. Asiatic Society of Japan.

Java.

Buitenzorg.

p. Jardin Botanique.

Luxembourg.

Luxembourg.

p. Société des Sciences Naturelles.

Malta.

p. Public Library.

Mauritius.

p. Royal Society of Arts and Sciences.

Netherlands.

Amsterdam.

AB. Koninklijke Akademie van Wetenschappen.

p. K. Zoologisch Genootschap 'Natura Artis Magistra.'

Delft.

p. École Polytechnique.

Haarlem.

AB. Hollandsche Maatschappij der Wetenschappen.

p. Musée Teyler.

Leyden.

AB. University.

Rotterdam.

AB. Bataafsch Genootschap der Proefondervindelijke Wijsbegeerte.

Utrecht.

AB. Provinciaal Genootschap van Kunsten en Wetenschappen.

New Brunswick.

St. John.

p. Natural History Society.

New Zealand.

Wellington.

AB. New Zealand Institute.

Norway.

Bergen.

AB. Bergenske Museum.

Norway—*continued.*

Christiania.

AB. Kongelige Norske Frederiks Universitet.

Tromsoe.

p. Museum.

Trondhjem.

AB. Kongelige Norske Videnskabers Selskab.

Nova Scotia.

Halifax.

p. Nova Scotian Institute of Science.

Windsor.

p. King's College Library.

Portugal.

Coimbra.

AB. Universidade.

Lisbon.

AB. Academia Real das Sciencias.

p. Secção dos Trabalhos Geologicos de Portugal.

Oporto.

p. Annaes de Sciencias Naturaes.

Russia.

Dorpat.

AB. Université.

Irkutsk.

p. Société Impériale Russe de Géographie (Section de la Sibérie Orientale).

Kazan.

AB. Imperatorsky Kazansky Universitet.

p. Société Physico-Mathématique.

Kharkoff.

p. Section Médicale de la Société des Sciences Expérimentales. Université de Kharkow.

Kieff.

p. Société des Naturalistes.

Moscow.

AB. Le Musée Public.

B. Société Impériale des Naturalistes.

Odessa.

p. Société des Naturalistes de la Nouvelle-Russie.

Pulkowa.

A. Nikolai Haupt-Sternwarte.

St. Petersburg.

AB. Académie Impériale des Sciences.

B. Archives des Sciences Biologiques.

AB. Comité Géologique.

Russia—*continued.*
p. Compass Observatory
A. Observatoire Physique Central.

Scotland.
Aberdeen.
AB. University.
Edinburgh.
p. Geological Society.
p. Royal College of Physicians (Research Laboratory).
p. Royal Medical Society.
A. Royal Observatory.
p. Royal Physical Society.
p. Royal Scottish Society of Arts.
AB. Royal Society.
Glasgow.
AB. Mitchell Free Library.
p. Natural History Society.
p. Philosophical Society.

Servia.
Belgrade.
p. Académie Royale de Serbie.

Sicily. (See Italy.)

Spain.
Cadiz.
A. Instituto y Observatorio de Marina de San Fernando.
Madrid.
p. Comisión del Mapa Geológico de Espãna.
AB. Real Academia de Ciencias.

Sweden.
Gottenburg.
AB. Kongl. Vetenskaps och Vitterhets Samhälle.
Lund.
AB. Universitet.
Stockholm.
A. Acta Mathematica.
AB. Kongliga Svenska Vetenskaps-Akademie.
AB. Sveriges Geologiska Undersökning.
Upsala.
AB. Universitet.

Switzerland.
Basel.
p. Naturforschende Gesellschaft.
Bern.
AB. Allg. Schweizerische Gesellschaft.
p. Naturforschende Gesellschaft.

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Switzerland—*continued.*

Geneva.

AB. Société de Physique et d'Histoire Naturelle.

AB. Institut National Genevois.

Lausanne.

p. Société Vaudoise des Sciences Naturelles.

Neuchâtel.

p. Société des Sciences Naturelles.

Zürich.

AB. Das Schweizerische Polytechnikum.

p. Naturforschende Gesellschaft.

p. Sternwarte.

Tasmania.

Hobart.

p. Royal Society of Tasmania.

United States.

Albany.

AB. New York State Library.

Annapolis.

AB. Naval Academy.

Austin.

p. Texas Academy of Sciences.

Baltimore.

AB. Johns Hopkins University.

Berkeley.

p. University of California.

Boston.

AB. American Academy of Sciences.

B. Boston Society of Natural History.

A. Technological Institute.

Brooklyn.

AB. Brooklyn Library.

Cambridge.

AB. Harvard University.

B. Museum of Comparative Zoology.

Chapel Hill (N.C).

p. Elisha Mitchell Scientific Society.

Charleston.

p. Elliott Society of Science and Art of South Carolina.

Chicago.

AB. Academy of Sciences.

p. Field Columbian Museum.

p. Journal of Comparative Neurology.

Davenport (Iowa).

p. Academy of Natural Sciences.

United States—*continued.*

Ithaca (N.Y.).
- *p.* Physical Review (Cornell University).

Lawrence.
- *p.* Kansas University.

Madison.
- *p.* Wisconsin Academy of Sciences.

Mount Hamilton (California).
- A. Lick Observatory.

New Haven (Conn.).
- AB. American Journal of Science.
- AB. Connecticut Academy of Arts and Sciences.

New York.
- *p* American Geographical Society.
- *p.* American Museum of Natural History.
- *p.* American Mathematical Society.
- AB. Columbia College Library.
- *p.* New York Academy of Sciences.
- *p.* New York Medical Journal.

Philadelphia.
- AB. Academy of Natural Sciences.
- AB. American Philosophical Society.
- *p.* Franklin Institute.
- *p.* Wagner Free Institute of Science.

Rochester (N.Y.).
- *p.* Academy of Science.

St. Louis.
- *p.* Academy of Science.

Salem (Mass.).
- *p.* American Association for the Advancement of Science.
- AB. Essex Institute.

San Francisco.
- AB. California Academy of Sciences.

Washington.
- AB. Patent Office.
- AB. Smithsonian Institution.
- AB. United States Coast Survey.
- B. United States Commission of Fish and Fisheries.
- AB. United States Geological Survey.
- AB. United States Naval Observatory.
- *p.* United States Department of Agriculture.
- A. United States Department of Agriculture (Weather Bureau).

West Point (N.Y.).
- AB. United States Military Academy.

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From the Syndics of the Cambridge University Press.

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From the Family of the late M. Daubrée.

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CATALOGUE OF OBJECTS AND EXPERIMENTS EXHIBITED AT THE CONVERSAZIONE HELD IN THE SOCIETY'S APARTMENTS IN BURLINGTON HOUSE ON MAY 19, 1897.

1. *Exhibited by Sir H. Trueman Wood, M.A.*

Illustrations of the Dansac-Chassagne process of producing Photographs in Colour.

The details of the method are not known. According to the Inventors' Patent Specification (No. 18,131, 1896), photographic prints (silver) are treated with a solution containing albumen and certain metallic chlorides, and afterwards with certain colouring materials (blue, green, and red). The process is stated to be entirely automatic.

2. *Exhibited by Sir A. Noble, K.C.B., F.R.S.*

Apparatus for ascertaining duration of explosion, pressure developed, and rate of cooling of products of combustion.

The recording instrument consists of a rotating drum, on which two pencils mark (1) seconds, (2) the pressure in tons per square inch indicated by a specially designed manometer; the pressure pencil traces out a curve, from which can be deduced the approximate time of explosion, the pressure reached, and the rate at which the gases cool; a second instrument is attached, on which the pressures and seconds are indicated by small electro-magnets.

3. *Exhibited by Mr. J. W. Swan, F.R.S.*

Stress Effects produced by Convective Electric Discharges.

Experimental demonstration of stress effects produced by electric discharges on the surface of a viscous mixture of resin and oil.

The figures shown are characteristic examples of the effect of + and − discharges on a resin surface, followed by exposure to dust and subsequent superficial heating sufficient to cause softening, and permit the movement of the dielectric. It will be noticed that the dust figures are nearly coincident with the indented figures, due to the mechanical stress generated by electrification. There is also an example of the effect of a single discharge, showing the + effect on one side, and the − effect on the opposite side of the same plate.

4. *Exhibited by Mr. W. Watson.*

Apparatus for the Comparison of Thermometers.

This piece of apparatus is an application of Ramsay and Young's method of obtaining a steady temperature to the problem of comparing a thermometer with a standard. The liquid employed to form the vapour jacket is boiled by means of the heat developed in a platinum wire by an electric current, as this method of heating entirely obviates bumping. The whole of the stems of the thermometers are heated to the same temperature as the bulb, thus avoiding a correction for cool-column. The pressure acting on the bulbs is constant, although if the pressure-coefficient has to be measured, the pressure can be varied.

5. *Exhibited by Mr. J. Wimshurst.*

A powerful Electrical Influence Machine.

The machine has twenty-four disks, each 3 feet in diameter; they are so arranged as to furnish three poles, one of which may be negatively charged, the other two positively charged, or at pleasure the reverse order may be followed; by this arrangement two separate streams of discharge may be in use at the same moment.

6. *Exhibited by Prof. Silvanus P. Thompson, F.R.S.*

1. Model of a Hertz Wave Transmission.

The transmission model is a simple wave-motion apparatus, transmitting a transverse vibration along a row of leaden balls, suspended so that each ball

gives a portion of its energy at each oscillation to the next in the series. The oscillator is a heavy suspended mass to which a blow is given; the resonator is a circle of brass hung on a trifilar suspension. Oscillator and resonator are tuned to the same period.

2. Two Kinematic Models.

One of the kinematic models illustrates the composition of two opposite circular motions of equal period and radius to form simple harmonic motion.

The other kinematic model illustrates the theorem that two simple harmonic motions of equal period and amplitude, but with any phase-difference, may be compounded together to give uniform circular motion, provided the space-angle at which they are placed is the supplement of their phase-angle.

7. *Exhibited by Dr. H. E. Armstrong, F.R.S.*

Graphic Representation of the Rothamsted Observations on the continuous growth of Wheat.

Wheat has been grown on the farm of Sir J. B. Lawes, Bart., at Rothamsted, Herts, continuously since 1844 on plots manured in the same manner year after year. The results have hitherto always been expressed numerically. The diagrams show:—

(1) The yield of grain in lbs. per acre on each of the plots;

(2) The yield of straw in lbs. per acre on each of the plots;

(3) The ratio of corn to 100 parts of straw on each of the plots;

(4) The average produce of the plots; also the corresponding results with barley;

(5) The effect of manuring in alternate years with either minerals and phosphate or ammonia salts.

8. *Exhibited by Mr. E. Warren.*

Certain Bones of the Ancient Naqada Race, exhibiting Characters of Morphological or Pathological interest.

This race has recently been discovered by Prof. Flinders Petrie, in his explorations in Egypt, and the date ascribed to it is about 3000 B.C.

The present collection was selected from the remains of over 200 skeletons. These skeletons have already been subjected to a statistical inquiry, and a few of the results are exhibited in the form of frequency curves.

9. *Exhibited by Dr. C. I. Forsyth-Major.*

1. Restored Skeleton of *Æpyornis Hildebrandi* (Burckhardt) from Madagascar.

The skeleton exhibited is the *first* and almost complete skeleton of *Æpyornis Hildebrandi* hitherto obtained from Madagascar.

2. *Nesopithecus Roberti* (Forsyth-Major) and other objects.

Remains of a fossil monkey of an entirely new genus and species.

Skin of a new type of aquatic insectivore *Limnogale mergulus*.

A selection of new genera and species of Madagascar mammalia.

Collected by Dr. C. I. Forsyth-Major during his residence in Madagascar, 1894–96. (The collection was made by means of grants from the Fund administered by the Royal Society.)

10. *Exhibited by Mr. Aubrey Strahan, M.A., F.G.S., through Mr. Horace B. Woodward, F.R.S.*

Glacial Phenomena of Cambrian or Pre-Cambrian Age, from the Varanger Fiord, Norwegian Lapland.

The specimens comprise portions of a glaciated surface of quartzite, and of a boulder-bed which rests upon it. The boulder-bed occurs as a lenticular mass interbedded in quartzites which are believed to be of Cambrian or Pre-Cambrian age. It contains many boulders of granite and other rocks, some of which are glaciated. The hardening of the quartzite and boulder-bed is due to the deposition of secondary silica. This is the earliest proved example of ice-action.

Some photographs accompany the specimens.

11. *Exhibited by the Astronomer Royal.*

Photographs of the Moon taken with the new Thompson 26-in. Photographic Telescope, at the Royal Observatory, Greenwich.

(1) Negative of Moon taken at principal focus (focal length 22 ft. 6 in.).

(2) Negative of Moon taken with enlarging lens at secondary focus (equivalent focal length about 105 ft.).

(3) Positives from (1) and (2), the former enlarged to the same scale.

(4) Enlargements on paper of (1) and (2).

12. *Exhibited from the Library of the Royal Society.*

Photographic Atlas of the Moon, published by the Observatory of Paris. Executed by MM. Lœwy and Puiseux.

Fascicule 1, 1896, containing six plates.

Planches I–V.—Héliogravures d'après les agrandissements sur verre de trois clichés des années 1894 et 1895.

13. *Exhibited by Mr. J. Norman Lockyer, C.B., F.R.S.*

1. Photographs illustrating enhanced lines in the Spectra of the Chemical Elements, and the importance of such lines in the Spectra of the Hotter Stars.

(*a*) Photographic comparisons of the arc and spark spectra of iron, calcium, and magnesium, showing the lines which are enhanced in passing from arc to spark.

(*b*) Photographs showing the distribution of characteristic arc and enhanced lines of iron, calcium, and magnesium in stars of increasing temperature.

(*c*) Photographs showing the distribution of these lines in stars of decreasing temperature.

(*d*) Photographic spectrum of α Cygni, showing the lines which have so far been identified with the enhanced lines of various substances. The majority of the α Cygni lines were previously classed as "unknown."

2. Solar Photographs, taken at Dehra Dun, India, showing a Kite and a Locust projected on the Sun's disk. Forwarded by Mr. J. Eccles, M.A.

3. Photographs illustrating the Spectroscopic Results obtained by the Eclipse Expedition to Novaya Zemlya, August, 1896.

4. Photographs illustrating preparations and arrangements for the observation of the Total Eclipse of the Sun, August, 1896, at Kiö Island, Varanger Fjord, Norway.

5. Photographic Comparison, showing the presence of a Fluting of Carbon in the Ultra-violet Spectrum of the Sun. Taken with a Rowland concave grating.

14. *Exhibited by Mr. A. A. C. Swinton.*

Experiments with Cathode and X-rays.

(1) A movable carbon screen is employed inside a Crookes tube of the focus type, for the purpose of investigating the form of the cathode discharge. The surface of the carbon becomes brightly luminescent where struck by the cathode rays, and from the luminous rings produced when the screen is placed so as to intersect either the convergent or the divergent cone of rays, it appears that both these cones are usually hollow.

(2) From the effect produced upon the luminous ring by intercepting some of the convergent rays, it appears that the cathode rays cross at the focus with no rotation.

(3) The employment of concave cathode disks of carbon renders the path of the cathode discharge brilliantly luminous at very high exhaustions, when with aluminium cathodes the discharge is invisible.

(4) The penetrative value of the X-rays produced by a focus tube can be varied, without altering the vacuum, (*a*) by altering the distance between the cathode and anti-cathode, (*b*) by varying the size of the cathode, (*c*) by altering the position of the cathode relatively to the glass walls of the tube, and (*d*) by means of a variable magnetic field.

(5) The penetrative value of the X-rays is independent of the material of which the anti-cathode surface is made; not so, however, the quantity of the X-rays, which is greatest with anti-cathode surfaces of high atomic weight.

15. *Exhibited by the Director, Royal Gardens, Kew.*

1. A Selection of Dried Plants from Tibet, collected by Captain Deasy and Mr. Arnold Pike, Captain Wellby and Lieut. Malcolm.

The majority of the plants of Tibet are peculiar to the region, though, with few exceptions, they belong to genera of wide range. Those here exhibited illustrate the general character of the plants forming the scanty and scattered vegetation at elevations of 15,000 to 19,200 feet above the level of the sea. A large development of root, combined with an almost entire suppression of stem, is characteristic.

2. Flower of *Aristolochia goldieana* (Western Tropical Africa), from a plant grown in the Royal Gardens, Kew.

16. *Exhibited by Mr. J. E. Stead, F.I.C.*

Photographs illustrating the Micro-structure of Alloys.

Micro-structure of alloys of lead and antimony; tin and antimony; tin and phosphorus; tin and arsenic; tin, antimony, and copper; tin, arsenic and antimony; illustrating the fact that when fluid mixtures of metals and non-metals cool down from the liquid to the solid state, crystals of definite chemical composition fall out of solution, and may be clearly seen under the microscope, after the polished surfaces have been etched by dilute acids, or tinted with suitable reagents, a condition of things which has been demonstrated by Prof. Roberts-Austen by an entirely different method of research.

17. *Exhibited by Mr. Eric Stuart Bruce, M.A.*

Some Photographs of Optical Projections in Space.

These are photographs of the persistent image produced in the retina of the eye, by means of the optical instrument the aerial-graphoscope. This instrument was exhibited at the Conversazioni of the Royal Society, 1889 and 1894. The camera has been made to retain and unite, in the same way as does the retina, the various minute portions of a lantern projection which appear in turn on the revolving lath of an aerial-graphoscope and seem to stand out in space, transparent, and in relief. Thus photographs are obtained of an image, which does not exist *as a whole* before the camera, and these are the first instance of such an application of photography. An exposure of from 10 to 25 minutes was necessary.

The aerial-graphoscope image appearing transparent to the eye, an object placed behind it can be seen through it, and in these photographs such real objects which were actually before the camera, are thus shown through the transparent image.

18. *Exhibited by Mr. E. Edser and Mr. H. Stansfield.*

Apparatus showing the Phase Change of Light Reflected at a Glass-silver Surface.

The apparatus exhibited is a modification of Michelson's Differential Refractometer, the interfering rays being reflected at the back surfaces of the end mirrors. On these surfaces are deposited silver films, one being wedge shaped, with a horizontal streak rubbed off, and the other uniform. Where vertical bands cross from the glass-air to the glass-silver surface a lateral displacement is produced, which varies from zero at the thin end of the wedge to three-fourths of a band at the thick end. The direction of the displacement indicates a retardation.

9. *Exhibited by Professor Roberts-Austen, C.B., F.R.S.*

Apparatus for Micro-photography.

A microscope and camera is arranged for obtaining photographs of metals and alloys under high magnification. The illustrations show the mode of existence of carbon in steel, and include the diamond form of carbon. The magnifications vary from 500 to 1,000 diameters.

20. *Exhibited by Mr. E. J. Bles.*

Living Specimens of *Proteus anguinus*, Laurenti.—(1) Male and Female; (2) Pigmented individual from cave; (3) Young specimen pigmented during nine months' exposure to light and increased temperature.

At the breeding season (April—May) secondary sexual characters are developed in the male, the caudal crest broadens, and the otherwise slight pigmentation becomes more pronounced. That this should take place in complete darkness, and the occurrence of individuals like No. 2 in total absence of light, demonstrates that the presence of visual rays is not a necessary condition for the formation of animal pigment. Specimen No. 3 shows the production of white, as well as black, pigment.

21. *Exhibited by Mr. E. T. Browne.*

A Collection of British Medusæ.

22. *Exhibited by M. C. E. Guillaume, Bureau International des Poids et Mesures.*

1. Experiments with Highly Dilatable and nearly Non-dilatable Nickel Steel.

2. Diagrams of Expansion.

3. Compensated Pendulum made of Nickel Steel.

Les recherches de l'auteur ont révélé une singulière anomalie de dilatation présentée par les aciers au nickel. Jusqu'à 20 pour 100 de nickel environ ces alliages se comportent sensiblement comme des mélanges ; mais, au dessus de cette teneur, les dilatations passent rapidement de la valeur 12×10^{-6} à la valeur 18×10^{-6}. Après un maximum assez brusque, les dilatations diminuent graduellement, pour atteindre, au voisinage de 36 pour 100, la valeur $0{\cdot}88 \times 10^{-6}$, sensiblement égale au dixième de la dilatation du platine. La dilatation remonte ensuite peu à peu.

La courbe de dilatation en fonction de la température présente, vers 30 pour 100, une forte concavité supérieure; elle se redresse—à mesure que l'on augmente la teneur en nickel, puis la courbure change de sens. (Voir diagrammes.)

Le rapport entre les plus fortes et les plus faibles dilatations ensuite des alliages étudiés est de 20 environ. Ces alliages se prêtent dònc particulièrement bien à la construction des systèmes compensés (voir pendule) pour lesquels la dernière propriété signalée permet d'annuler simultanément les termes des deux premiers degrés.

23. *Exhibited by Mr. C. T. Heycock, F.R.S., and Mr. F. H. Neville.*

1. Superficial Colour Changes of a Silver-zinc Alloy.

This alloy, of the composition AgZn, is normally white, but when heated to 300° C., or above, and suddenly chilled below 150°, it becomes superficially a bright red. The colour disappears when the alloy is heated to 150°, and does not then return if the alloy is cooled, but it can be recovered by repeating the above process.

2. X-ray Photographs of Sodium-gold Alloys.

These photographs show the crystals of gold and of sodium existing in alloys that to the eye appear to be homogeneous. Dilute, saturated, and supersaturated solutions are exhibited, which illustrate the processes that take place during the solidification of a mixture.

24. *Exhibited by Mr. E. K. Scott.*

1. Improved Hatchet Planimeter.

The hatchet edge or keel consists of a sharp-edged wheel, thus avoiding cutting the paper and side slip, and by reducing friction, enabling irregularities of the figure to be readily followed. A small wheel with recording disc is provided for measuring the distance between the first and last positions of the keel. The wheels are attached to a moveable head, which slides along the graduated stang; lengthening bars being provided for use with large areas, such as maps.

The tracing point consists of a small hole in a flat, transparent celluloid plate.

2. The Cyclesograph, an Instrument for describing Arcs of Circles of large radius.

This instrument is principally intended to take the place of the wooden curves which are commonly used, with the important advantage that it can be adjusted instantly to give any radius of curvature. The curve traced out is not an approximation, but is rigorously an arc of a circle.

The scale of the instrument as shown is graduated from 50 cm. radius upwards.

25. *Exhibited by Mr. C. P. Butler, A.R.C.S.*

The Diffraction Kaleidoscope.

A series of four slides, showing the evolution of the instrument from an ordinary diffraction grating.

(1) A simple grating, having 6,000 lines to the inch.

(2) Showing change in appearance produced by combining two of these gratings.

(3) The effect of combining four gratings, by the relative rotation of which the varying colour patterns are produced.

(4) The appearance that would be presented by the combination of an infinite number of such gratings, or, in other words, a grating ruled in concentric circles instead of straight lines.

26. *Exhibited by Dr. G. H. Fowler.*

A Mid-water Tow Net.

The net having been lowered to the lowest depth required, is opened by a "messenger," which travels down the rope: the net is then hauled vertically upwards, and can be closed at any point by a second "messenger." The fauna of any mid-water zone, between the surface and the bottom, can be captured by this means, without mixture with the fauna of other zones.

27. *Exhibited by Mr. Shelford Bidwell, F.R.S.*

Rotating Disks, showing subjective Colour Phenomena.

About one-half of the surface of a disk is made black, and the other half white, an opening being cut at the junction of the black and white portions. A design in black lines upon a white ground, seen under suitable illumination through the opening in the rotating disk, appears to be red. This phenomenon depends upon the fact that a bright object, when suddenly exposed to view, appears for a moment to be surrounded by a red border. (See 'Roy. Soc. Proc.,' December, 1896, p. 368.)

The same apparatus demonstrates a novel method of exhibiting *Negative After-images*. A coloured object under strong illumination is caused to assume a tint complementary to its natural hue. Thus red is seen as green, and green as pale red, while a black patch upon a white ground appears whiter than the ground itself. The sensibility of the nerve-fibres of the retina is, in fact, appreciably diminished by exposure to coloured light for a period so brief that the eye cannot recognise the true colour of the light.

28. *Exhibited by Professor Oliver Lodge, F.R.S.*

Demonstration of Zeeman's Discovery of the Broadening of Spectrum Lines by the Action of a Magnetic Field on the Source of Light.

Sodium lines produced by an oxyhydrogen flame between the poles of a powerful magnet are examined by means of a Rowland concave grating (the one with which Mr. George Higgs photographed the solar spectrum), and can be seen to broaden whenever the magnet is excited. A nicol or other analyzer shows that the light of changed refrangibility is polarised, as it would be if the source of radiation consisted of revolving electrified particles whose motion is accelerated or retarded by magnetic lines of force through the plane of motion.

Recent Observation.—By reason of reversals, the usual appearance of each sodium line is as if it were double; the magnetic field makes it appear triple, or even quadruple. A nicol properly oriented removes the magnetic effect. D_1 shows it more sharply than D_2. The new lines intrude into the middle, after the fashion of Newton's rings.

29. *Exhibited by the Marine Biological Association.*

Commensalism amongst Marine Animals.

The term commensalism is used to indicate the constant association of two or more animals together, often for mutual advantage. Commensalism differs from parasitism in the fact that neither of the associated animals feeds on the tissues of the other, nor lives directly at the expense of the other. A number of living examples found at Plymouth of marine animals, which thus live together as "messmates," will be exhibited.

30. *Exhibited by Mr. J. Goold.*

Experiments on the Transmutation of Sound-vibrations.

(1) A large steel plate is set in vibration by means of a synchronising generator. Without a resonator there is very little audible sound, but on bringing the plate into contact with a common deal board its vibration is at

once transformed into a loud harmonic chord. The notes of the chord are those proper to strings.

(2) A dish of mercury placed on the nodal region of a vibrating plate exhibits a brilliant series of ripples.

(3) Melde's cord-spindles, oscillating membranes, &c.

31. *Exhibited by Mr. J. E. S. Moore.*

Examples of Animal-forms peculiar to Lake Tanganyika.

The exhibit consists of a number of fishes, crustacea, gasteropods, medusæ, sponges, and drawings of protozoa, which are peculiar to Lake Tanganyika, and which are possibly the survivals of an oceanic fauna which may have existed at some time in the region of the lake.

They were obtained during an expedition to Lake Tanganyika, which was organised in order that the remarkable fresh water fauna of the lake might be studied on the spot.

The expedition was supported by a grant, made in 1895–96, from the Fund administered by the Royal Society.

32. *Exhibited by Dr. A. A. Kanthack, Mr. W. F. H. Blandford, F.E.S., and Mr. H. E. Durham, M.B.*

The Tsetse Fly, and the parasite of Tsetse Fly-disease or Ngana.

The tsetse fly disease, familiar during the past fifty years as a scourge to domestic animals in Central and South Africa, has been recently shown by Surgeon-Major Bruce to be due to the presence in the blood and serous fluids of the affected animals of a parasitic protozoon (*Trypanosoma*).

Surgeon-Major Bruce has proved experimentally that the parasite may be present in the blood of wild animals shot in the "Fly Country," which, however, are not known to suffer from its presence. The part played by the fly appears merely to be that of communicating the micro-organism from infected to healthy animals. The disease of animals known as "Surra" in Asia is closely allied to Ngana, and a similar parasite occurs in this country in the rat, but without producing the same fatal effects.

Dried specimens of the fly, specimens of the Ngana hæmatozoon, both alive and stained, and of the rat hæmatozoon, are exhibited.

33. *Exhibited by Dr. Woodward, F.R.S., on behalf of Mr. R. Damon.*

1. Egg of *Æpyornis maximus* (Grandidier), Madagascar.

The longest circumference is 31 inches; girth, or shortest circumference, 26 inches.

2. Egg of African Ostrich for comparison of size.

3. Photograph of a Fossil Frog (*Discoglossus Troscheli*, Meyer sp.) from the Lignite (Miocene) of Rott, near Bonn, and Skiagraph of a Recent Frog of the same genus (*Discoglossus pictus*, Otth), for comparison. By Messrs. James Green and James H. Gardiner.

34. *Exhibited by Dr. Woodward, F.R.S., for Mr. J. G. Robertson, of Dublin.*

Ceratereeton Galvani, Huxley, Coal Measures, Kilkenny, Ireland.

Skeleton of a small Labyrinthodont Reptile, originally described in 'Trans. Roy. Irish Acad.,' 1867, vol. 24, p. 354, pl. xix, figs. 1—4.

35. *Exhibited by Mr. F. Enock, F.L.S.*

1. Living Specimens of the British Mymaridæ (Egg Parasites) Terrestrial and Aquatic.

2. Mounted Specimens of newly discovered Genera. Mounted Specimens of newly discovered Male Prestwichia.

The Mymaridæ are a small family of parasitic Hymenoptera hitherto represented by some eleven genera, containing thirty-five species. This number has been increased by eight new genera and many species. These most minute winged insects (the smallest one eighty-fifth of an inch long) lay their eggs within those of other insects, which are then destroyed by the tiny larva feeding upon the contained fluid, which is sufficient to sustain the parasite until it has reached maturity, when it bites a hole in the shell and escapes.

Caraphractus cinctus, Hal, uses its wings for swimming under water.

36. *Exhibited by Dr. M. Standfuss, of Zurich.*

1. Specimens of Lepidoptera altered by Temperature Experiments, and reared by the Exhibitor.

Series A. Operated upon by temperature in the pupal stage only, and which strikingly vary from the normal form of the species.

Series B. Obtained by the application of abnormal temperatures from the egg onwards.

2. Some of the Results of Crossings carried out by the Exhibitor.

Series A. Products of the crossing of various species and the issue of these crossings by recrossing the hybrid males with the females of the original species, or the pairing of these males with the females of a third species.

Series B. Products of the crossing between various local races of the same species.

37. *Exhibited by Mr. F. Merrifield.*

Examples of Alteration of Insects by Temperature applied in the Pupal Stage.

The temperatures were mostly three, viz.: (1) *Forced*, about 80° F. to 104° F.; (2) *cooled*, about 43° F. to 52° F.; (3) *iced*, about 34° F. Summer pupæ are generally much more affected than winter pupæ, which in most species are not affected at all. The pattern appears generally to be most affected by temperature in the early pupal stages; the colouring often in the later pupal stages. In the summer pupa of such a species as *S. tetralunaria* the combinations of winter pattern with summer colouring, and summer pattern with winter colouring, of which examples are exhibited, can thus be produced on moths proceeding from the same parents.

38. *Exhibited by Lord Walsingham, F.R.S.*

Some Examples of Geographical Distribution among the Micro-Lepidoptera, with Specimens from different Regions, and Coloured Maps.

These delicate and short-lived insects, being almost exclusively phytophagous, and frequently attached not only to the same genus but to the same species of food-plant, are probably less adapted than any others for migration or artificial distribution, it is therefore difficult to explain many of the examples here illustrated, whether cosmopolitan, zonal, or sporadic, the normal distribution of such insects being extremely local.

39. *Exhibited by Dr. C. A. MacMunn.*

Blood Corpuscles of some Invertebrate Animals. Digestive Gland of *Ostrea.*

In the connective tissue, especially of the digestive gland, of the oyster, certain corpuscles containing pigmented spherical bodies occur. The latter seem to be reserve products, and they are coloured by a chlorophylloid pigment. They resemble symbiotic algæ, but are quite different, as their microchemical reactions show.

40. *Exhibited by Sir David Salomons, Bart., M.A.*

A Rotating Mirror, specially made to the order of Exhibitor by the Cambridge Instrument Company.

A rotating mirror, for continuous running at a speed of 48,000 turns per minute. The speed is ascertained by the counterpoised pin striking a piece of paper, thus giving a definite note or rather a whistle. The suspension is such that no vibration whatever is transmitted to the supporting table, and the apparatus runs with perfect smoothness and absence of noise. The ¼ H.P. motor has been removed to lighten the instrument. The apparatus is not shown in action, because of the possibility of the splashing of oil.

41. *Exhibited by Mr. F. C. Atkinson.*

A Rowing Indicator, giving Continuous Record.

An ordinary indicator diagram is recorded on a strip of paper on the drum by a pencil, rotating with the oar, and moving vertically as the pressure of the oar compresses the spring.

During the "swing forward" after a stroke has been recorded, automatic gear winds the diagram strip into a new position, while other gear obtains a diagram, if desired, of only every fifth stroke. With this instrument details with regard both to style and horse-power can be secured of a course of 500 strokes.

42. *Exhibited by Professor J. Norman Collie, F.R.S., and Captain H. H. P. Deasy.*

A new Pocket Mercurial Standard Barometer.

The chief advantage is that the barometer can be coiled up and packed away in a small compass. It does not easily get out of order, and can be

subjected to shaking and rough usage; also, owing to a glass tap, it is almost impossible for air to enter when packed, and should the mercury become dirty, it can, owing to the simple construction of the instrument, at once be taken to pieces and cleaned.

43. *Exhibited by Dr. Gore, F.R.S.*

An Apparatus for Investigating the Influence of Proximity of Substances on Voltaic Action.

An apparatus by means of which the influence of radiations from a variety of substances at ordinary atmospheric temperatures upon volta-electromotive force has been investigated, and the effect of screens of various metals upon that influence has been examined. A full description of the apparatus, and an account of the results obtained with it, will be published in the 'Philosophical Magazine.'

44. *Exhibited by Professor W. F. R. Weldon, F.R.S.*

Micrometer for Microscopic Measurement of large objects. Manufactured by the Cambridge Scientific Instrument Company.

45. *Exhibited by Mr. E. H. Griffiths, F.R.S.*

Earth Thermometer. A simple apparatus for the determination of earth temperatures.

This can be used by any observer capable of reading an ordinary mercury thermometer. There are no plugs or loose contacts in the circuit, and thus the apparatus is not likely to be injured by exposure.

All the arms being equal and similarly situated, the readings (being comparative) are not affected by the rise of temperature due to current heating. Thus comparatively large currents can be used, and the necessity of using a delicate galvanometer is done away with.

The apparatus is especially designed for the use of the "Second Class Observers" employed by the Meteorological Office. Its accuracy, however, is only limited by that of the mercury thermometer, by means of which the readings are taken.

46. *Exhibited by Mr. T. A. B. Carver, B.Sc., and Mr J. E. Barnard, F.R.M.S.*

Experiments Illustrating a new Method of Controlling the Electric Arc in its application to Photomicrography.

A higher degree of accuracy in the centration of the crater is found to be necessary than can be obtained with ordinary apparatus; and the amount of increase in the length of the arc required to start automatic mechanism is sufficient to produce decentration of the light, to the corresponding detriment of the photographic result. Absolute constancy in the position of the centre of light is secured, in the apparatus exhibited, by the aid of an independent gauge, consisting of a pin-hole casting a multiplied image of the arc on a ground-glass screen, in reference to lines upon which the position and length of the arc can be continuously observed, and adjusted by the simplest form of hand-feed mechanism.

47. *Exhibited by Mr. L. Kamm.*

Kamm's "Zerograph," or "Printing Telegraph System."

The "Zerograph" is a telegraphic type-writer, with keys arranged as an ordinary type-writer. The apparatus acts as a transmitting or receiving instrument, and is constructed for various telegraphic systems, such as duplex, quadruplex, stock exchange, and in combination with the telephone system. The apparatus is entirely automatic and permanent in synchronism. It requires no attendance when messages are received. These are printed on both the receiving and transmitting instruments. A mechanism with an electro-magnetic arrangement is employed to produce the motion, which necessitates only two impulses at various intervals of time for each letter or sign to be printed. The instruments are constructed to print in columns and also on tapes, the latter is simplifying the instrument to a great extent.

48. *Exhibited by Mr. Casella.*

New Phototheodolite, designed by Mr. J. Bridges-Lee, M.A.

49. *Exhibited by Professor W. E. Ayrton, F.R.S.*

Experimental Demonstration of "Some Electric and Mechanical Analogues."

50. *Exhibited by Professor J. B. Farmer.*

Lantern Slides from Micro-photographs, illustrating Nuclear Division in Animal and Vegetable Cells.

Slides will be shown illustrating the process of fertilisation and segmentation of the egg in *Ascaris megalocephala* and in *Fucus vesiculosus*.

ANNIVERSARY MEETING.

1897.

On Tuesday, November 30, being St. Andrew's Day, the Anniversary Meeting of the Society was held in their apartments in Burlington House,

The LORD LISTER, F.R.C.S., D.C.L., LL.D., President, in the Chair.

The Report of the Auditors of the Treasurer's Accounts, on the part of the Society, was presented as follows:—

"The total receipts on the General Account during the past year, including balances carried from the preceding year, amount to £9,800 6*s*. 10*d*., and the total receipts on account of Trust Funds, including balances from the preceding year, amount to £4,424 5*s*. 4*d*. The total expenditure for the same period amounts to £7,850 14*s*. 6*d*. on the General Account, and £2,320 14*s*. 1*d*. on account of Trust Funds, leaving a balance on the General Account of £1,915 19*s*. 10*d*. at the bankers (which includes £1,000 of Dr. Ludwig Mond's gift on deposit), and in the hands of the Treasurer a balance of £33 12*s*. 6*d*.; leaving also at the bankers a balance on account of Trust Funds of £2,103 11*s*. 3*d*."

The thanks of the Society were voted to the Treasurer and Auditors.

The Secretary read the following Lists:—

Fellows deceased since the last Anniversary (Nov. 30, 1896).

On the Home List.

Archer, William, M.R.I.A.
Ballard, Edward, M.D.
Bucknill, Sir John Charles, M.D.
Franks, Sir Augustus Wollaston, K.C.B.
Haughton, Rev. Samuel, D.C.L.
Heywood, James, M.A.
Hicks, John Braxton, M.D.
Jervois, Lieutenant-General Sir William Francis Drummond, G.C.M.G.
Mundella, Right Hon. Anthony John.
Parker, T. Jeffery, D.Sc.
Parsons, Robert Mann, Major-Gen. R.E.
Roy, Charles Smart, M.D.
Salter, Samuel James Augustus, M.B.
Stone, Edward James, D.C.L.
Sylvester, James Joseph, D.C.L.
Tomlinson, Charles, F.C.S.

On the Foreign List.

Des Cloizeaux, Alfred Louis Olivier.
Du Bois-Reymond, Emil Heinrich.
Heidenhain, Rudolph P. H.
Sachs, Julius von.
Steenstrup, Johannes Japetus Smith.
Weierstrass, Carl.

Change of Name and Title.

Lister, Sir Joseph, Bart., *to* Lister, Lord.
Smith, Rev. F. J., *to* Jervis-Smith, Rev. F. J.

Fellows elected since the last Anniversary.

Bell, Robert, LL.D.
Broadbent, Sir William Henry, Bart.
Chree, Charles, M.A.
Elwes, Henry John, F.L.S.
Gorst, Right Hon. Sir John Eldon, Q.C.
Haldane, John Scott, M.D.
Haswell, Prof. William A., D.Sc.
Howes, Prof. George Bond, F.L.S.
Kipping, F. Stanley, D.Sc.
Mathews, Prof. George Ballard, M.A.
Murray, George Robert Milne, F.L.S.
Neville, Francis Henry, M.A.
Nicholson, Prof. H. Alleyne, M.D.
Thomson, Prof. John Miller, F.C.S.
Trouton, Prof. Frederick Thomas, M.A.
Turner, Prof. Herbert Hall, M.A.

On the Foreign List.

Amagat, Émile Hilaire.
Cohn, Ferdinand.
Gibbs, J. Willard.
Heidenhain, Rudolph P. H.
Hoff, J. H. van't.
Koch, Robert.
Lacaze-Duthiers, Henri de.
Pfeffer, Wilhelm.
Wislicenus, Johannes.
Zirkel, Ferdinand.

The following Report of the Council, which had been previously distributed to the Fellows, having been taken as read, was, on the motion of the President, received:—

REPORT OF THE COUNCIL.

Many of the subjects referred to by the President in his Address at the last Anniversary have continued to engage the attention of the President and Council during the past year.

Among the most important duties discharged by the Council is that connected with the consideration of papers communicated to the Society, with a view to ultimate publication in the "Philosophical Transactions" or "Proceedings." In this duty they

have received the most valuable assistance from the Sectional Committees, which were appointed under the Standing Orders mentioned in the last Presidential Address, and which now present a record of their first complete year of working.

In all, 116 papers were received between the close of the Session, 1896, and the corresponding period in 1897. Of these, 37 were submitted for publication in the "Philosophical Transactions," and 70 in the "Proceedings"; and 23 and 75 have been ordered for publication in the two categories respectively.

During the past year 22 papers have been published in the Mathematics and Physics section, and 10 in the Biological section of the "Philosophical Transactions." The two sections together contain in all 1,312 pages of letterpress and 22 plates. Nineteen numbers of the "Proceedings" have been issued, containing 991 pages and 9 plates.

A meeting for discussion, in accordance with the regulations contained in the Standing Orders adopted last year, was held in March of the current year. The discussion was based on a paper contributed by Sir Norman Lockyer "On the Chemistry of the Hottest Stars"; this, together with some of the principal contributions to the discussion, has been printed in the "Proceedings."

In pursuance of the resolution of the International Conference on a Catalogue of Scientific Literature, the Council at the beginning of the session, upon receiving the report of the British delegates to the Conference, and in accordance with the 26th resolution of the Conference, viz. :—

> (26) "That the Royal Society be requested to form a Committee to study all questions relating to the Catalogue referred to it by the Conference, or remaining undecided at the close of the present sittings of the Conference, and to report thereon to the Governments concerned,"

appointed a Committee with full executive powers. This Committee has since been engaged in developing a scheme for the preparation of the projected complete Catalogue of Scientific Literature.

The Committee has held a number of meetings, has devoted much time to the discussion of the difficult questions which arise in devising methods for carrying out so large a scheme as that contemplated by the Conference, and has appointed a number of special Sub-Committees for drawing up schemes of classification for the several branches of science.

In view of the resolutions of the Conference, it appeared desirable to establish a (provisional) British Catalogue Committee, which might be consulted by the Committee of the Royal Society on questions relating to the collection and preparation of the material supplied by the scientific literature of Great Britain and Ireland, and might ultimately develop into the National Bureau for the United Kingdom contemplated by the Conference.

An appeal was, therefore, made by the Royal Society's Committee to the chief Societies representative of the

sciences to be included in the Catalogue, and to certain important libraries, requesting the appointment of representatives.

Excepting in two cases, in which the nominations are delayed, all the societies and libraries applied to nominated representatives as requested.

At the first meeting of the British Committee thus constituted, representatives of nearly all the sciences included in the invitation attended, and expressed the willingness of the bodies they represented to co-operate in the work of the International Catalogue, though in some cases it was stated that they would not be able to contribute towards the expenses.

The further action to be taken by the various societies towards carrying out the work indicated above, will be considered by committees specially appointed by them for the purpose, and will form the subject of reports to be made to the British Committee.

With the object of keeping the Delegates to the International Conference informed as to the work of the Committee, and of eliciting from them suggestions and criticisms upon the matters still under discussion, an *ad interim* statement of the progress so far made in its deliberations has been sent confidentially to all the Delegates.

Progress continues to be made with the "Catalogue of Scientific Papers" and with the classified Index thereto.

As regards the Supplementary portion of the Catalogue, the transcription of the copy is now approaching completion, and the Council hope that the first instalment of copy may be ready for the printer early in the new year. During the year ending on October 31st, about 130 serials have been indexed for the purposes of the Catalogue, representing approximately 774 volumes, and involving the transcription of about 41,000 titles.

Of the classified Index to the Catalogue, about 275,000 slips have now been prepared, of which about 100,000 have been translated. An experimental classification of these slips is being made, in the course of which about 53,000 have already been classified under the eleven divisions sanctioned by the Catalogue Committee. During the past year about 65,000 slips have been prepared, of which about 13,000 have been revised, or translated, as occasion required.

Under the regulations for the administration of the Government Grant Fund, the Council have, upon the recommendation of the Government Grant Committee, made Grants amounting to £3,115, in addition to a Grant of £1,500 made to the Joint Permanent Eclipse Committee out of the Reserve Fund towards the expenses of observing the approaching Solar Eclipse.

Early in the year, the Council appointed a Committee, called the Government Grant Review Committee, to report upon the manner in which the Grants made from the Government Grant have been expended, and on the scientific results thereby attained. The Committee has met, but has not yet reported to the

Council. The question of the re-appointment of the Committee to make an annual report on the subject referred to them is under consideration.

The Report upon the results of the Expedition sent out last year, under the direction of a Committee of the Royal Society, to investigate the structure of a Coral Reef by boring, was presented to the Society in a paper which was printed in the "Proceedings" of February 18, 1897 (vol. lx, p. 502). In that report, the Chairman of the Committee expressed the opinion that a more successful attempt would probably be made from Australia, and the Council therefore heard with satisfaction early in March that the authorities at Sydney would probably be willing to renew the attempt at boring with some assistance in money and influence from the Royal Society. Later, the Council was informed that a second expedition had been despatched from Sydney with the assistance of the Royal Geographical Society of Australasia, on the agreement that the core, when recovered, should be sent to the Royal Society, and that all scientific details of the results of the Expedition should be reserved for the Royal Society to publish. On the recommendation of the Coral Reef Committee, the balance remaining in hand from last year's Expedition was voted in aid of the Australian Expedition.

Early in the present month, the Secretaries received a preliminary report from Prof. David, in which he informed them that on September 6th the boring had attained a depth of 557 feet, and in the lower part had pierced more than one mass of coral limestone, one—about 20 feet thick—ending at 550 feet; they have also been informed that the boring was continued after the above-named date, and was still proceeding in generally similar material to that above, at a depth of 643 feet.

The Joint Permanent Eclipse Committee has organized expeditions for the observation of the Total Solar Eclipse in January next; and at the request of the Committee, applications have been made to the War Office for leave of absence for Capt. Hills, R.E., in order that he may take part in the observation of the Eclipse; to the India Office, for facilities for the landing of instruments free of duty; to the Admiralty, for the conveyance of one of the observing parties to and from their observing station in one of H.M.'s ships; and to the Colonial Office, for facilities for the transhipment of that party from a passenger steamer to the ship of war at Colombo.

All these requests have been acceded to by the authorities.

The Committee appointed last year at the request of Her Majesty's Secretary of State for the Colonies, to investigate the subject of the Tsetse Fly Disease in South Africa has, in the course of the year, through Drs. Kanthack and Durham, and Mr. Blandford, conducted a careful investigation into the disease so far as it can be studied in this country, in subjects inoculated

from a dog sent over from South Africa by Surgeon-Major Bruce. The Committee have, at the same time, been in communication with Surgeon-Major Bruce, keeping him informed of the progress of the inquiry here, and offering him suggestions for further investigation in South Africa. The experimental investigations, under Dr. Kanthack, are being pursued at Cambridge, with the aid of a Grant of £200, generously placed at the disposal of the Council by Mr. A. Beit for this purpose. A letter, however, has recently been received from the Colonial Office, stating that Surgeon-Major Bruce's investigations have, for the present, been suspended, and he himself has been directed to return to military duty. The investigations have, so far, not resulted in the indication of any practical preventive treatment of the disease, but the life-history of the hæmatozoon, discovered by Surgeon-Major Bruce and shown by him to be the essential cause of the disease, has been carefully studied, and still presents problems of great interest.

Acting upon the recommendations of the Scientific Relief Committee, the Council has during the year granted £545 to assist scientific men or their relatives in distress. Early in the year the Council found it expedient to codify the practice and original regulations, which had been modified from time to time since the formation of the Scientific Relief Fund, in a series of regulations for the guidance of the Committee in the administration of the Fund. The revised regulations will be printed in the new edition of the "Year-book."

In January the Council received a letter from the Royal Society of Canada urging them to move the Government to give their adhesion to a scheme for the unification of time at sea by the assimilation of the astronomical and civil day, with a view to the necessary alteration being made in the "Nautical Almanac" for 1901. The Council appointed an influential committee to consider the question, and received from them the following report:—

"The Committee report that as there is a great diversity of opinion amongst astronomers and sailors as to the advisability of the adoption of civil reckoning for astronomical purposes, and as it is impossible to carry out such a change in the 'Nautical Almanac' for the year 1901, they do not recommend that the Royal Society should at present take any steps in support of the suggested change of reckoning."

Acting upon this advice, the Council have for the present refrained from taking any steps in support of the suggested change of reckoning.

The biennial election to the Joule Studentship was, under the terms of the Trust, placed by the Council last year in the hands of the Académie des Sciences, Paris, which has conferred the award on M. Jules Perrin, Doctor of Sciences, of the Ecole Normale.

Early in the year, the attention of the Council was called to the system of teaching Natural Science in schools, and a Conference on the subject was arranged between the President and Council and the Fellows appointed by the Society as members of the governing bodies of the public schools. At this Conference an interesting discussion on the subject took place, and a general expression of opinion as to the desirability of attaching increased importance to the teaching of science as a necessary element of education, was recorded; but the Council has not at present decided upon taking any further steps in the matter.

About a year ago the President and Council were invited by the Council of the British Association to co-operate in approaching Her Majesty's Government with a view to the establishment of a National Physical Laboratory. At the suggestion of the President and Council, a Joint Committee was formed to discuss the question, and to take action in furtherance of the desired object. This Committee waited upon Lord Salisbury, and laid before him the arguments in favour of the scheme. As a result a Committee has been appointed, with Lord Rayleigh as Chairman, to consider the desirability of establishing such a laboratory, and is now sitting. This Committee recently invited the Royal Society to appoint one or two Fellows to give evidence before the Committee on the subject under reference, and the President and Council have accordingly invited Lord Kelvin and Prof. Oliver Lodge to undertake this duty, which they have accepted.

In May last the Council received a request from Sir Benjamin Stone to nominate representatives upon the preliminary Committee for carrying out a scheme for a National Collection of Photographic Records, and Prof. Lapworth and Prof. Meldola were accordingly appointed to serve on the Committee.

Occasion arose during the past year for the exercise of the functions assigned in 1885 to a Committee designated the Indian Observatories Committee, which, however, has been held to be not a Committee of the Royal Society. The Astronomer Royal having called the attention of the President and Council to the anomalous position of this Committee, it was decided to appoint a new Committee of the Royal Society, to be named the Observatories Committee, to advise the Council on any questions similar to those formerly referred to the Indian Observatories Committee.

Reports have been received from the Kew Observatory Committee (published in the "Proceedings"), the Water Research Committee, and the Meteorological Council.

The Library continues to grow, especially in the section of scientific serials, and, although two book-cases have been added in the saloon, the question of shelf accommodation must soon

become a matter for serious consideration. During the past year 10 new serial publications have been added to the 440 which the Society already received at regular intervals by exchange or purchase. Of these 450 serial publications, about

46	are issued in	monthly	parts
14	„	weekly	„
10	„	fortnightly	„
10	„	quarterly	„

and the remainder at irregular intervals.

Besides these, 53 complete books have been added to the library by presentation or purchase. Among these may be specially mentioned the first volume of the Scientific Papers of the late Prof. J. Couch Adams, two further volumes of the Collected Papers of Prof. Cayley, Sir Joseph Hooker's "Journal of Sir Joseph Banks," Capt. Lyons's "Report on the Islands and Temples of Philæ," the Procès-Verbaux of the "Conférence Internationale des Étoiles Fondamentales de 1896," and the completion of Helmholtz's "Physiologische Optik."

In the course of last summer the Council resolved to present a dutiful address to Her Majesty the Queen, on the occasion of the celebration of the sixtieth year of Her reign. The text of the address, and an account of its presentation, together with the text of Her Majesty's most gracious reply, were laid before the Society at its first meeting.

The President then addressed the Society as follows:—

Since the last Anniversary Meeting fifteen Fellows and six Foreign Members have passed away.

The deceased Fellows are—

Edward Ballard, January 19, 1897, aged 76.

Charles Tomlinson, February 15, 1897, aged 89.

Samuel James Augustus Salter, February 28, 1897, aged 72.

James Joseph Sylvester, March 15, 1897, aged 83.

Edward James Stone, May 9, 1897, aged 66.

Major-General Robert Mann Parsons, May 20, 1897, aged 68.

Sir Augustus Wollaston Franks, May 21, 1897, aged 72.

Sir John Charles Bucknill, July 19, 1897, aged 79.

Right Hon. Anthony John Mundella, July 21, 1897, aged 72.

William Archer, August 14, 1897, aged 65.

Lieutenant-General Sir William Francis Drummond Jervois, August 17, 1897, aged 76.

John Braxton Hicks, August 28, 1897, aged 74.

Charles Smart Roy, October 4, 1897, aged 43.

James Heywood, October 17, 1897, aged 87.

Rev. Samuel Haughton, October 31, 1897, aged 76.

Thomas Jeffery Parker, November 7, 1897, agen 47.

The Foreign Members are—

Emil Heinrich du Bois-Reymond, December 26, 1896, aged 79.
Carl Weierstrass, February 20, 1897, aged 82.
Alfred Louis Olivier Des Cloizeaux, May 8, 1897, aged 79.
Julius von Sachs, May 29, 1897, aged 65.
Johannes Japetus Smith Steenstrup, June 20, 1897, aged 84.
Rudolph P. H. Heidenhain, October, 1897, aged 63.

Of these some seem to demand special notice from this Chair.

In Sylvester, English mathematical science has lost one of its best known and most gifted exponents. During his long and active career he wrote several hundreds of memoirs on the most refined and technical parts of pure mathematics. It is not for me to attempt to enumerate even the most important of his labours, which were as solid as they were brilliant. To quote the words of one well qualified to judge, "originality, imagination, and enthusiasm were the ever present notes in the chords which he struck with a master's hand; and it may be safely predicted that he will always find an honoured place in the small roll which contains the names of the men who have been pre-eminent in the science which he loved and to which he devoted his life."

Our Fellow for more than fifty years, he received the highest recognition our Society can bestow, having been awarded a Royal Medal in 1861, and the Copley Medal in 1880. No less was he honoured by other countries, foreign scientific academies having showered their distinctions upon him. Thus full of honours, as of years, he died at the advanced age of 83.

In Sir Augustus Wollaston Franks we have lost one of the most distinguished Archæologists of this or any other country. During a connexion with the British Museum extending over a period of forty-five years, he practically founded the Department of British and Mediæval Antiquities and Ethnography, and its growth was in no small degree due to his private liberality.

In all that related to the subject of the Antiquity of Man, he was one of our first authorities; and the Christy collection of which he was a trustee, and which is now incorporated with the British Museum, assumed its present great importance under his careful superintendence and through his generous aid. The mediæval collections which he bequeathed to the nation testify alike to his taste and judgment and to his rare munificence.

The Rev. Dr. Haughton was a man of great intellectual power and amazing versatility. He made original contributions, based often upon very laborious researches, to physics, chemistry, geology, biology, and medicine, while continuing to discharge from time to

time the functions of a minister of the gospel. If his many-sidedness prevented him from attaining a high eminence in any one branch of science, it pre-eminently fitted him for the place he was to fill in the government of a large educational institution.

After receiving his school education in his native town of Carlow, he proceeded to Trinity College, Dublin, where, his brilliant studentship having procured him a Fellowship at an unusually early age, he threw himself with great zeal into the educational work of the University. As a boy he had been fond of geology, and as a young man he so greatly distinguished himself in it that at the age of 30 he was appointed to the geological chair in Trinity College. Here he found himself unable to deal satisfactorily with fossil remains without a knowledge of comparative anatomy, and for this an acquaintance with human anatomy seemed an essential preliminary. Thus he was drawn to Medicine, for which indeed he had an early predilection; and entering comparatively late in life on medical study, he devoted himself to the entire curriculum with characteristic energy. Soon after he had taken his medical degree, an epidemic of cholera occurred in Dublin, and he showed the true spirit of a devotee of Medicine by placing himself at the head of a band of medical students, to supply the want of any adequate system of nursing. In this self-denying labour Haughton bore more than his full share, and its beneficial results left in his mind an abiding sense of the value of bedside work. He was thus led to found medals for the encouragement of clinical study; and the last act of his life was, out of very scanty savings, to provide for making those rewards more substantial.

In the course of his studentship he had been deeply impressed with the abuses which then existed in the medical department of Trinity College, and on becoming connected with the governing body, he entered on the task of reform with indomitable courage; and it was mainly due to his exertions that the school was raised from a comparatively subordinate position to the leading place which it now holds.

The high opinion entertained of him by his colleagues was shown by the fact that he was for many years their representative on the General Medical Council. He was of a most genial and loyal nature, and it is said of him that, while he made many friends, he never lost one.

Edward Ballard was one of the chief promoters of the sanitary science of the Victorian era. His researches into problems regarding public health, which extended over 40 years, were characterised by very remarkable far-sightedness and exactitude. To him we are indebted for most of our certain knowledge on the subject of effluvium nuisances in their relation to health, and for the indication

of trustworthy means of mitigating the deleterious influences of noxious trades. He, too, was among the first to insist on the importance of strict study of the ætiological relations of "sickness" and "mortality"; and by his labours in this connexion he laid a foundation for that system of compulsory notification of infectious illness which is now practically universal in this country. But Dr. Ballard's completed work in these and other directions by no means represents the full measure of the value of his services to public health. By his industry in the accumulation of facts bearing on a number of unsolved problems, and his exposition of such facts in their several connexions, he has not only indicated lines of further research, but has tended to lighten the labours of those who will come after him. He was a man of noble nature; and the devotion of his great abilities to the service of mankind was utterly devoid of self-seeking.

James Heywood was a man of considerable scientific attainments, who deserves to be specially remembered on account of his great services in the cause of university reform. He was born in 1810 at Everton, Lancashire, and on leaving school at Bristol, entered Trinity College, Cambridge, where he was Senior Optime in 1833. He could not, however, proceed to his degree until twenty-three years later, on account of the religious tests which were only abolished in 1856 by the Cambridge University Reform Act. Of this, as member for North Lancashire, he was the chief promoter; for, already in 1854, he moved and carried, after several previous attempts, a clause by 233 against 78, in favour of the abolition of religious tests for the Bachelor's degree in Arts, Laws, Medicine, and Music. There can be no doubt that this fundamental reform led the way to the introduction of experimental science into our universities.

He was one of the original trustees of Owens College, Manchester, and took a keen interest in the establishment and development of the scientific chairs in that institution. He was elected into the Royal Society in 1839, and was, at the time of his death, the Fellow of longest standing.

On the 19th of February last, Karl Weierstrass, one of our Foreign Members, died in his eighty-second year. He was elected a Foreign Member in 1881, and in 1895 the Copley Medal was awarded to him in recognition of the contributions he had made to pure mathematics. The grounds on which the award was made, were set out in the President's Address in that year; and so it is not necessary now to refer in detail to his researches. The results which he obtained and the rigorous precision of method which he adopted have made his influence remarkable; and it can fairly be claimed for him that he is not the least eminent on the roll of the great mathematicians of the century.

Alfred Des Cloizeaux was a veteran mineralogist of great eminence. His first paper was published fifty-four years ago and was the beginning of a long series treating of the forms and optical characters of crystals. After being Professor of Mineralogy for eighteen years at the Ecole Normale Supérieure, he was appointed to the charge of the minerals at the Musée d'Histoire Naturelle, in which office he remained until he reached the limit of age prescribed by the rules of the French Civil Service. His fame rests upon the thoroughness and accuracy of his systematic investigation of the crystals of minerals, more especially as regards their optical properties. The results are incorporated in his 'Manuel de Minéralogie,' a standard book of reference. Professor Des Cloizeaux died in the eightieth year of his age.

In Julius von Sachs botanical science has lost one of the most conspicuous figures of the latter half of the century. His widespread influence was due in the main to two memorable books.

In his 'Experimental-Physiologie' (1866) he at once put the subject on a new footing. He returned to the methods long ago pursued by Hales and Knight in this country, and, while giving a critical estimate of the results achieved by his predecessors, everywhere turned the light of experimental investigation on the problems presented by the living plant. The success which he met with was due to a broad grasp of general principles and a singular directness of aim at the object in view, associated with great experimental skill. In his mechanical ingenuity and aptitude for making simple yet effective appliances he somewhat resembled Faraday.

His 'Lehrbuch' (1868) produced a profound impression on the teaching of botany both in Europe and America. It did for botany what Gegenbaur achieved for zoology, in presenting the morphological facts of the vegetable kingdom for the first time as a whole. As with the 'Experimental-Physiologie,' it was no mere compilation, but was at every point subjected to the test of original investigation.

Sachs, moreover, presented the somewhat unusual combination in science of great gifts of original investigation accompanied by no less great gifts of exposition. The insight of his attack on a problem was equalled by the masterly lucidity with which he expounded his results.

Emile du Bois-Reymond, who died in December of last year at the age of seventy-eight, was a Foreign Member of the Royal Society since 1877. Although born in Berlin, he was of French-Swiss extraction, his father being a native of Neufchâtel, and his mother belonging to a French Huguenot family. He studied in the Universities of Berlin and Bonn, and took his Doctor's degree in Medicine in Berlin. In 1840, at the age of twenty-two, he became the assistant of Johannes Müller, whose successor he was appointed, in the chair

of Physiology in Berlin, in 1858. He has himself told us that it was Johannes Müller who first turned his attention to the study of animal electricity, to which the labours of his life were chiefly devoted. His publications on the subject were very numerous, while his observations were characterised by mathematical accuracy which stamped them as trustworthy. And it is not too much to say that his discoveries constitute the main fabric of our knowledge of animal electricity.

Although his energies were chiefly devoted to one branch of physiology, he was not unmindful of other departments of the science. Ever since 1859 his name has been associated with the editorship of the 'Archiv für Anatomie und Physiologie,' which he carried on in conjunction with Reichert, after the death of Johannes Müller. He was a man of wide sympathies and high culture. His semi-popular discourses, scientific, literary, and historical, are models of well-selected language, clear exposition, and deep erudition. His address "On the Limits of Natural Knowledge" has passed through numerous editions, and has been translated into many languages. Du Bois-Reymond ranks with men like Bernard, Brücke, Helmholtz, and Ludwig, as one of those by whom the science of modern physiology has been built up.

As regards the work of the Society during the past year I have little to add to the Council's Report.

On the 15th of July I had the honour of taking part in a deputation to the Queen at Windsor to present the address of congratulation which had received the sanction of the Society. On this memorable occasion I was accompanied by the other officers, including all the Vice-Presidents, and also by three former Presidents, whom we all revere, Sir Joseph Hooker, Sir George Stokes, and Lord Kelvin. Her Majesty received us in person, and made the following very gracious reply:—

"I thank you for your loyal and dutiful Address. I am much gratified by the attachment which your ancient and learned Society expresses to my Throne and Person.

"I am fully sensible how far the labours and ingenuity of men of science, whom you worthily represent, have advanced the industrial and social prosperity of My people, and have tended alike to their good and refinement, and I confidently expect the same excellent fruit in years to come from the indefatigable and reverent investigation of Nature for the promotion of which the Royal Society was founded."

In the early part of the year a deputation from the Royal Society, the British Association, and several others of the most important scientific and technical societies, waited upon the Prime Minister to urge upon him the importance of establishing in this country a

National Physical Laboratory in which the testing and verification of instruments and the construction and improvement of standards of various kinds should be undertaken in a regular and systematic way. There was nothing new in principle in this proposal. Work of the kind referred to has for many years been carried out at Kew under the auspices of the Royal Society. It has been as successful as the limited means at the disposal of the Kew Observatory Committee would allow; and all that is needed is sufficient State aid to enable work of the same kind to be done on a larger and more useful scale.

It is satisfactory to be able to state that the efforts of the deputation were not in vain. A committee, of which Lord Rayleigh is chairman, has been appointed by the Treasury to investigate and report upon the desirability of the scheme. Evidence is being taken, and we may fairly hope that the Government will finally consent to promote an undertaking which could not fail to advance the interests both of pure science and of scientific industry.

In January last I was requested by the Council to approach the India Office in order to call their attention to Yersin's treatment of bubonic plague, which was causing such grave anxiety in the Bombay Presidency. I gladly undertook this service, as I had been greatly impressed with an account which that distinguished man, himself an independent discoverer of the plague bacillus, had given of a trial he had made of his remedy in China. The cases were, indeed, not very numerous, but the success recorded was most striking, and was in every detail so exactly proportioned to the shortness of the duration of the disease at the time when the treatment was begun that it was difficult to conceive it to be a matter of accidental concomitance. A similar correspondence of results with theory, taken along with complete trustworthiness of the source of information, had made me early feel and express confidence in the analogous serum treatment of diphtheria, which has since proved of such signal benefit to the community.

I was received at the India Office with the utmost cordiality, and I am not violating confidence when I say that my representations tended to strengthen the Home Government in their disposition to afford encouragement to M. Yersin to labour in the stricken district.

The vague rumours which reached us some time ago regarding his work in Bombay were not of an encouraging character. But I was glad to see from a paper read lately by M. Metchnikoff at the International Medical Congress in Moscow, that the treatment had been by no means a complete failure, and that the smaller degree of success than that obtained in China was sufficiently explained by the fact that the serum in the present state of knowledge takes a very long time to prepare, and Yersin had been obliged to employ

what he knew was not as potent as that which he used in China. We may therefore fairly hope that in due time, if the pestilence should last so long, the original full measure of success will be again obtained.

The communications made to the Society during the year have been of a high order of excellence. In illustration of this I must content myself with referring to two examples taken from the domains of physics and biology respectively. The remarkable series of ten papers by Professors Dewar and Fleming, describing their continued researches on the electric and magnetic properties of matter at low temperatures, have brought before us new facts of fundamental importance. Such, for instance, is their discovery that at very low temperatures the electrical resistance of bismuth is remarkably increased by transverse magnetisation; so much so that the observations seem to indicate that at the absolute zero pure bismuth would be a perfect conductor if not in a magnetic field, but a perfect non-conductor if transversely magnetised.

The illustration which I will take from the domain of biology is the recent communication of Mr. Gardiner on the Histology of the Cell-Wall. Before 1883, when his former paper on this subject was published in our 'Proceedings,' other observers had seen and described threads passing through the walls of certain vegetable cells, and supposed to connect the protoplasm of one cell with that of adjacent ones. But the observation had only been made in certain exceptional cases, and, moreover, they were not of such a character as in Mr. Gardiner's opinion to afford conclusive evidence that the threads really consisted of protoplasm. Since the date referred to he has laboured at this most important subject with remarkable ingenuity and perseverance; and by new methods of preparation, varied to overcome the special difficulties presented by the various forms of tissue, he has succeeded in demonstrating, throughout the long series of cases which he has already examined, the presence of threads of undoubtedly protoplasmic nature, often of exquisite delicacy, passing in large numbers through the walls of adjacent cells, not only where they are thinned by the presence of pits, but elsewhere also. And to use his own words, "there can be little doubt that such connecting threads occur universally in the cells of all the tissues of all plants. From this arises the fundamental conception that the plant body must be regarded as a connected whole." And the transmission of impulses and of nutrient material from one part of the vegetable organism to another, quite unintelligible as long as the protoplasm of each cell was believed to be shut off from that of its neighbours by a wall of cellulose, receives a ready explanation.

The attendance at our meetings during the past session has been

very satisfactory. There can be no doubt that the great improvement which has taken place of late years in this respect has been in no small measure due to the alteration of the time of meeting to the afternoon, which is more convenient to the large majority of the Fellows than the evening. I thus freely admit that the change has been very advantageous, although I was opposed to it when it was made, as I was apprehensive that it would interfere with participation of members of my own profession in the work of the Society; for I should greatly regret anything like a severance of Medicine from the Royal Society, believing as I do that they are very helpful to each other, medical practice affording the suggestion and stimulus of much scientific investigation, while it is often the ultimate test of the validity of the conclusions arrived at.

At the risk of seeming to dwell too much upon matters connected with the healing art, I am tempted to refer to one recent instance of its intimate connexion with science. In the Society's 'Proceedings' for 1893* appeared a paper by Dr. Monckton Copeman, relating important researches on Variola and Vaccinia, and referring to a discovery which he had announced two years previously at the International Hygienic Congress, in London,† that an admixture of glycerine in certain proportions with vaccine lymph derived from the calf had the effect of causing, in no long time, the disappearance of what he termed the "adventitious microbes" invariably present in that material at the outset, without diminishing the efficacy of the lymph for the purpose of vaccination. It had been known before that glycerine might be added to the lymph without destroying its vaccinal property, but that it would thus cause the disappearance of concomitant microbes was quite new. In the scant intervals of leisure permitted by his duties as inspector under the Local Government Board, Dr. Copeman has continued to prosecute his researches. He has ascertained, among other things, that if tubercle bacilli are intentionally mixed in considerable quantity with the lymph, they soon lose their life under the influence of the glycerine, thus removing the last rational objection that could be urged against vaccination. For while the use of calf lymph excludes the possibility of conveying human disease in general by the process, the cow, like man, is liable to tuberculosis. It is true that tubercle is very rare in the young animal, and that the practice of killing the calf after it has furnished the vaccine and subjecting the body to competent inspection before the lymph is set aside for use, would reduce the risk of communication of the disease almost to zero. But it is satisfactory to learn that Dr. Copeman's process makes such a thing absolutely impossible. It further turns out that the use of the glycerine, so

* Vol. 54, p. 187.

† 'Trans. of Internat. Congress of Hygiene,' 1891.

far from impairing the efficacy of the lymph for vaccination, considerably enhances it; so that it becomes susceptible of large dilution, one calf thus furnishing material for a much greater number of vaccinations than was formerly thought possible. And further the glycerinised lymph being stored in sterile glass tubes, the chance of contaminating the vaccination scratches with extraneous impurities, somewhat difficult to prevent in vaccinating directly from the calf, is entirely avoided. Lastly, it has been found that the inflammatory disturbance at the seat of vaccination in the human arm, with concomitant febrile disturbance, is greatly lessened by the use of the pure essential ingredient.

Comparatively little advantage has yet been taken of the system in this country. But it has been otherwise abroad; and the English Commission on Vaccination having made favourable reference to the subject, the President of the Local Government Board recently requested their Medical Officer, Sir Richard Thorne Thorne, to make a tour of inspection of the Continental practice. In this he was accompanied by Dr. Copeman, and we learn from the report which they have issued that they found our countryman's precepts very extensively acted on in the various countries which they visited. In Germany, especially, they are carried out with the thoroughness characteristic of that nation, so much so that while arm to arm vaccination has been entirely discarded, the use of glycerine-stored lymph has almost entirely superseded the practice of vaccinating from calf to arm.

It has given me pleasure to learn that Mr. Chaplin is likely soon to propose legislation for the purpose of giving the full benefits of this valuable process to the country of its discoverer.

It afforded great though melancholy satisfaction to the Treasurer and myself to be present last Christmas at the final obsequies of the man to whose labours is due the possibility of carrying on such investigations as those just referred to. M. Pasteur was buried in his own "Institut" with a splendour befitting the memory of so great and good a man.

I have also been glad to be the means, as President of the Society, of aiding our French brethren in erecting a monument to him to whom the world in general owes so much. Having received last year a letter from the Perpetual Secretary of the French Academy inviting my help in raising a fund to supplement that which was being subscribed in France, I called a meeting held here on March 26 of last year, at which it was decided to form a committee, in order to collect contributions to the International Pasteur Memorial. I wrote in the first instance to such of our Fellows as are members of the Academy, requesting them to allow their names to be on the committee, and received in almost every instance a

cordial assent. Our Treasurer having consented to act as treasurer to the fund, and Professor Percy Frankland undertaking the somewhat onerous duties of secretary, a sum has been raised, amounting in all to £877 0*s.* 3*d.*, from which £17 7*s.* 2*d.* was deducted for expenses, leaving a balance of £859 13*s.* 1*d.*

I know that our French friends were much gratified by this result; and I learn from a letter written to the Treasurer by M. Bertrand, acknowledging a final cheque, that the monument in Paris promises to be worthy of its object.

It is noteworthy that rather more than half the entire sum contributed has come from India, chiefly from the medical officers, through Surgeon-General Cleghorn. It seems probable that their great liberality was prompted by a sense of gratitude for the good work done on Pasteur's lines in that great dependency, such as Haffkine's preventive inoculations against cholera, and the efforts being made to cope with the plague in Bombay.

I have the sad pleasure, if I may so express myself, of announcing that my old friend, that distinguished medical officer and very gallant soldier, Sir William Mackinnon, late Director-General of the Medical Department of the Army, has, by will and codicils dated 1896 and 1897, after making certain specific legacies, including one of £2,000 to the University of Glasgow, bequeathed the whole residue of his property to the Royal Society, subject to certain life annuities. The proceeds of the fund are to be applied by the Royal Society for the foundation of such prizes and scholarships for the special purpose of furthering Natural and Physical Science, including Geology and Astronomy, and for furthering original research and investigation in Pathology, as the Society may think best and most conducive to the promotion of those sciences and of original discoveries therein; such prizes and scholarships to be called after the name of the testator.

A preliminary meeting of the trustees has been held, and although the precise state of affairs is not yet determined, we learn that the net residue of the estate given in trust for the Royal Society will produce, when the debts and legacies are paid, between £6,000 and £8,000, and that upon the cessation of the annuities bequeathed by the will, the capital sum which will be set aside to produce those annuities (and which will be represented by a sum of about £12,000) will also fall in for the benefit of the estate. Thus the ultimate result of Sir William's kind confidence in the Society will be an addition to our resources of something between £16,000 and £20,000. And whatever doubt there may be as to the expediency of multiplying medals, there can, in my opinion, be none as to the value of scholarships for the promotion of original research.

Copley Medal.

Professor Albrecht von Kölliker, For. Mem. R.S.

The Copley Medal is given to one who well deserves the highest honour that it is in the power of the Royal Society to confer. For nearly sixty years past Albrecht von Kölliker has made contributions of the highest value to histology, embryology, and comparative anatomy. Though his labours have embraced so wide a field, they have always been of a high order of excellence, and have often been of far-reaching significance.

His early histological discoveries were invaluable for the systematic development of the cell theory. Of these I must, on the present occasion, content myself with referring to two, his demonstration of the continuity between the nerve fibres and nerve cells of Vertebrata in 1845, followed by his memoir on nerve cells in 1849; and his isolation in 1848 of the cellular elements of smooth muscular tissue, together with his essay on the distribution of smooth muscle in the vertebrate body, and his final demonstration of the existence of muscular tissue in the walls of the blood-vessels, where its presence, although previously asserted by Henle and Sharpey, was at the time denied by Arnold and many others.

These are examples of the histological results achieved by von Kölliker during the first ten years of his scientific activity. They are of fundamental importance, and they have been followed by a long series of other valuable histological discoveries. The whole series show not only his power as an investigator, but the wide range of his knowledge, and the eagerness with which he has appreciated and applied whatever was new in the work of others. This last quality is well shown in his various essays on the structure of the nervous system, from his early acceptance of Remak's statements concerning non-medullated nerves, to his work of the last few years.

Professor von Kölliker's influence upon histological science is due not only to his fame as an investigator, but in part also to his skill as a teacher and as a writer. Every successive edition of his text-book has been an important addition to the literature of the subject.

Among his embryological papers, that dealing with the development of Cephalopods, dating from 1844, is still a standard work, and figures copied from it are to be found in most modern text-books. His memoir on the development of Amphibia (1846) contains important statements on the behaviour of the nucleus during segmentation, and on the formation of cartilage and blood-vessels. The papers on the development of the skull (1849–50), and the subsequent work on the part played by the notochord and its sheath in

the formation of the vertebral column, must be mentioned as of fundamental importance. His many later researches on mammalian embryology, which are summarised in the various editions of his text-book of vertebrate embryology, need not now be mentioned in detail.

Although it is as a histologist that von Kölliker is pre-eminently distinguished, his zoological papers are numerous and important. Among his labours in this direction were his early demonstration of the unicellular nature of the Gregarinidæ, his description of the Dicyemidæ, his memoirs on the structure and development of the Hydroids and Medusæ, and his later magnificent works on the Alcyonaria.

Many of von Kölliker's papers have appeared in the 'Zeitschrift für Wissenschaftliche Zoologie,' founded by him and von Siebold in 1848, of which he is still one of the chief editors. It is pleasing to know that, at the advanced age of 80, he is still able to prosecute with unflagging zeal his work as an investigator and as a teacher. One of the reasons of his absence to-day is his reluctance to leave his lectures.

Royal Medal.

Professor Andrew Russell Forsyth, F.R.S.

One of the Royal Medals is awarded to Professor Andrew Russell Forsyth on account of his contributions to the progress of pure mathematics.

He is known principally for his excellent treatises on many subjects of mathematical analysis. These works are not mere compilations; they contain original work, and exhibit great creativeness of thought.

The treatise on Differential Equations was immediately successful, and established firmly his reputation as a teacher. This was followed by a scholarly work on Pfaff's problem, and, later, by the treatise on the Theory of Functions, the first in English on the subject, and noteworthy for the manner in which the parallel theories of Cauchy, Riemann, and Weierstrass are marshalled. The appearance of this work is responsible for the newly awakened interest in this country concerning the great works on this subject of Weierstrass, Jordan, Klein, Lie, Poincaré, and Mittag-Leffler.

Professor Forsyth is, in addition, a prolific author on other subjects covering a wide range of pure mathematics.

Royal Medal.

Lieut.-General Sir Richard Strachey, F.R.S.

The other Royal Medal is conferred on Lieutenant-General Sir Richard Strachey for his investigations in physical and botanical

geography, geology, and meteorology. Two of the most recent of these are recorded in his report, published in 1888, on the Barometrical Disturbances and Sounds produced by the Eruption of Krakatoa, and in his paper in the 'Phil. Trans.' of 1893 entitled "Harmonic Analysis of Hourly Observations of the Temperature and Pressure at British Observatories." These, while important in themselves, were but the last of a long series of valuable memoirs. He was the first to treat scientifically of the physical and botanical geography, geology, and meteorology of the Western Himalaya and Tibet. He also first observed the occurrence of a regular series of fossiliferous rocks, from the Silurian upwards, to the north of the great snowy axis of the Himalaya. His numerous papers on these subjects, dating from the year 1847, are published in the Journals of the Bengal Asiatic, Geological, and Royal Geographical Societies, in the Royal Society's 'Proceedings,' and in the Reports of the British Association.

Sir R. Strachey's scientifically annotated and very complete botanical collections made in Kumaon, during his physical survey of that province (in company with Mr. Winterbottom), and in Tibet, at all elevations from 2,000 to 18,500 feet, are unique in value and interest, as being the first from which could be determined the successive zones of vegetation according to altitude in the mountains of any part of Asia.

Sir R. Strachey is justly regarded as the founder of scientific meteorology in India, whether by virtue of his early personal labours in that branch of science, or for the zeal and energy with which, during his long career as a member, first of the Government of India in that country, subsequently of the Council of the Secretary of State, he promoted the establishment of meteorological observatories and stations all over our Eastern dominions. Nor were his exertions in this respect confined to meteorology, for there are few scientific institutions or publications now supported by the Indian Government which are not largely indebted for their existence or organisation to his efforts, and his active support largely contributed to the establishment of the organised Forest Department which has been so successfully carried out by Sir D. Brandis and his successors.

Davy Medal.

Dr. John Hall Gladstone, F.R.S.

The Davy Medal is awarded to Dr. John Hall Gladstone on the ground of the great extent and value of his chemical and physical researches, extending over a period of forty-nine years. His first paper was printed in 1847, and his last in the 'Proceedings of the Royal Society' for 1896. During this time he has published seventy-

six papers recording the results of his own researches, and forty-eight relating to investigations made in conjunction with other workers.

These papers cover a wide range of subjects. In chemistry he showed, in 1847, that urea is formed by the breaking up of some of the salts of fulminic acid. He demonstrated the composition of the so-called iodide of nitrogen. His memoir on the relations of the atomic weights of the elements suggested analogies with the homologous series of organic compounds. An important monograph on chemical affinity occupies forty-five pages of the 'Philosophical Transactions' of 1855; in it the behaviour of salts in solution is discussed with much acuteness.

Amongst Dr. Gladstone's other very numerous contributions to chemical science, may be mentioned. the study of the influence of carbonic anhydride on the germination of plants, his researches on the chemistry of storage batteries, on the molecular weight of caoutchouc and gums, and on the zinc-copper couple and its application to the production of organo-zinc compounds and the hydrides of the organic radicals. Dr. Gladstone's new and simple method of producing organo-zinc compounds conferred a most valuable boon upon organic chemistry, and led to the very extensive use of these bodies in organic research, and consequently to many important discoveries in that domain of chemistry.

Amongst Dr. Gladstone's numerous researches in physical chemistry, may be mentioned the following:—"On the Spectra produced by Solutions of Coloured Salts in Hollow Prisms"; "On the Use of the Prism in Qualitative Analysis" (1857). He shows that when a coloured acid and base combine, a solution of the salt so formed only allows those rays to pass which are not absorbed by either constituent separately. He taught us the optical detection of didymium in the same year, and also studied the influence of heat on the colour of saline solutions, showing that whilst in some cases the intensity only of the colour was altered, in others the tint was completely changed. In 1860 he published a useful paper on the use of the polariscope in chemical investigation. Of his other papers on physical subjects, the following may be mentioned:—"On the Connection between the Optical Behaviour, Specific Gravity, and Chemical Composition of Ethereal Oils"; "On the Refraction Equivalents of some Elements"; "On the Refraction and Dispersion Equivalents of Chlorine, Bromine, and Iodine"; "On the Refraction Equivalents of Carbon, Hydrogen, Oxygen, and Nitrogen;" "On the Specific Refraction and Dispersion in Isomeric Bodies"; and (with Dr. Perkin) "On the Relation between Molecular Magnetic Rotation and the Refraction and Dispersion of Nitrogenous Compounds."

One of Dr. Gladstone's most important investigations was the determination of the refractive equivalents of many of the metals.

The object was not, however, only to determine these equivalents, but also to answer the question whether any of the elements possessed more than one refractive equivalent. As the refractive indices of the metals could not, on account of their opacity, be directly determined, he operated upon solutions of their salts, first proving, in cases where both solid and solution were available, that the refraction was the same in the solid and in its solution, whether the solvent was aqueous or alcoholic, and whether concentrated or dilute. As the refraction equivalents of all sodium compounds were between 3 and 3·9 less than the corresponding potassium compounds, it was proved that the electro-negative constituent of the salt had the same optical effect no matter with what metal it was combined. By taking the refractive equivalent of potassium as 8, and dividing it by the atomic weight (39) of potassium, he obtained for the specific refractive power of that element the number 0·205, and by a similar series of determinations the specific refractive power of sodium, lithium, magnesium, barium, strontium, calcium, zinc, nickel, cobalt, lead, and mercury were ascertained.

Buchanan Medal.

Sir John Simon, F.R.S.

The Buchanan Medal is presented to Sir John Simon, who may fairly be termed the founder of modern sanitary science.

When, in consequence of the appalling facts relating to the condition of the indigent classes in London which were brought to light by the Sanitary Commission of 1843, powers were conferred by the Legislature on the Corporation for the improvement of so much of the metropolis as is under their control, John Simon was appointed Medical Officer of Health of the City. In this capacity he brought into existence a system of sanitary administration which has served as the model on which similar systems have been organised, not only in Great Britain, but throughout the civilised world.

In 1855, the knowledge and experience gained by Mr. Simon during his tenure of office in the City were made available for the country at large by his appointment to the Central Medical Officership then created under the General Board of Health; and when in 1858 the powers of that Board were transferred to the Privy Council, he became Medical Adviser of the Government. He held this office for fifteen years, during which he not only energetically and effectually promoted measures of sanitary improvement both in town and country, but initiated a system of scientific investigations to be conducted year by year at the public expense, and it is deeply to be regretted that his plans were not fully carried out.

The funds for this medal were supplied by Sir John Simon's late distinguished pupil, Sir George Buchanan, and it is fitting that the first award should be to the master.

On the motion of Lord Kelvin, seconded by Professor Lankester, a vote of thanks was accorded to the President for his address, with a request that he would allow it to be printed.

The Statutes relating to the election of Council and Officers were then read, and Mr. Lazarus Fletcher and Professor Silvanus Thompson having been, with the consent of the Society, nominated Scrutators, the votes of the Fellows present were taken, and the following were declared duly elected as Council and Officers for the ensuing year:—

President.—Lord Lister, F.R.C.S., D.C.L.

Treasurer.—Sir John Evans, K.C.B., D.C.L., LL.D.

Secretaries.—Professor Michael Foster, M.A., M.D., D.C.L., LL.D.
Professor Arthur William Rücker, M.A., D.Sc.

Foreign Secretary.—Sir Edward Frankland, K.C.B., D.C.L., LL.D.

Other Members of the Council.

Prof. William Grylls Adams, M.A.; Prof. Thomas Clifford Allbutt, M.D.; Sir Robert Stawell Ball, M.A.; Rev. Thomas George Bonney, D.Sc.; Prof. John Cleland, M.D.; Prof. Robert Bellamy Clifton, M.A.; Prof. James Alfred Ewing, M.A.; Alfred Bray Kempe, M.A.; John Newport Langley, D.Sc.; Joseph Larmor, D.Sc.; Prof. Nevil Story Maskelyne, M.A.; Prof. Raphael Meldola, F.C.S.; Prof. Edward Bagnall Poulton, M.A.; William James Russell, Ph.D.; Dukinfield Henry Scott, M.A.; Prof. Walter Frank Raphael Weldon, M.A.

The thanks of the Society were given to the Scrutators.

Balance Sheet. 1897.

Statement of Receipts and Expenditure from November 13th, 1896, *to November* 12th, 1897.

	£	s.	d.
To Balance at Bank, 13th November, 1896	300	12	1
„ „ on Deposit (Dr. Ludwig Mond's Gift)	1,304	17	3
„ Balance in hand, Petty Cash	21	17	10
„ „ Wages Account	13	1	10
	34	19	8
„ Compositions	180	0	0
„ Admission Fees	10	0	0
„ Annual Contributions, 101 at £4 £404 0 0			
„ 219 at £3 £657 0 0	1,061	0	0
„ Fee Reduction Fund, in lieu of Admission Fees and Annual Contributions	370	0	0
„ Rents:			
Fee Farm, Lewes £18 11 4			
Mablethorpe Estate £80 11 3	99	2	7
„ Ground Rents	553	17	6
„ Dividends (exclusive of Trust Funds)	1,982	11	7
„ Interest on Mortgage Loans (Duke of Norfolk)	514	5	4
„ Sale of Transactions and Proceedings	754	2	9
„ Interest on Bank Deposit Account	4	9	7
„ Interest on Bank Deposit (Dr. Ludwig Mond's Gift)	19	6	8
„ Sale of Catalogue	18	9	7
„ Transfer from Handley Fund on account of Catalogue	185	10	4
„ Sale of Krakatoa Report (leaving £61 0*s.* 4*d.* Expenditure in excess of Receipts)	1	10	0
„ Sale of Lendenfeld Monograph (leaving £6 48 16*s.* 1*d.* Expenditure in excess of Receipts)	1	8	0
„ Treasury, Publication Grant, 3 half-years	1,500	0	0
Carried forward	8,896	2	11

	£	s.	d.
By Salaries, Wages, and Pension	1,707	4	0
„ Catalogue of Scientific Papers	559	12	6
„ Index to ditto	290	10	6
	850	3	0
„ Books for the Library	307	1	4
„ Printing Transactions, and Separate Copies to Authors and Publisher	1,047	19	6
„ Ditto Proceedings, Nos. 358 to 376	623	13	7
„ Ditto Miscellaneous	215	14	9
„ Paper for Transactions and Proceedings	439	17	6
„ Binding ditto	134	8	8
„ Engraving and Lithography	375	10	2
	2,837	4	2
„ Soirée and Reception Expenses	221	11	8
„ Anniversary Expenses	33	18	0
	255	9	8
„ Coal, Lighting, &c.	190	13	10
„ Electric Lighting Plant	39	2	0
„ Office Expenses	68	5	3
„ House Expenses	249	6	0
„ Tea Expenses	16	16	0
„ Fire Insurance	55	5	0
„ Taxes	13	5	3
„ Law Charges	10	15	9
„ Advertising Meetings	17	6	6
„ Postage, Parcels, and Petty Charges	131	14	1
„ Miscellaneous Expenses	63	7	3
	855	16	11
„ Carrington Donation	30	0	0
„ Publication Grant Payments	290	0	0
Carried forward	7,132	19	1

Statement of Receipts and Expenditure from November 13th, 1896, to November 12th, 1897—continued.

	£	s.	d.
Brought forward	8,896	2	11
To Transfer from Publication Grant to General Purposes on Account of Illustrations	80	0	0
„ Coral Boring Committee, Loan Repaid	300	0	0
„ Mr. A. Beit's Gift for Tsetse Fly Inquiry	200	0	0
„ Transfer from Dr. Ludwig Mond's Gift on account of Catalogue	324	3	11
	£9,800	6	10

	£	s.	d.	£	s.	d.
Brought forward				7,132	19	1
To International Catalogue				59	17	6
„ Tsetse Fly Account Payments				121	16	9
„ Tsetse Fly Report Payments				117	4	2
„ Record and Year Book Payments				94	13	1
„ Transfer from Dr. Ludwig Mond's Gift to General Purposes on account of Catalogue				324	3	11
„ Balance at Bankers :—						
Publication Grant	1,264	10	0			
Water Research	29	11	10			
	1,294	1	10			
Less General Purposes Overdraft	378	2	0			
				915	19	10
„ Ditto on Deposit (Dr. Ludwig Mond)				1,000	0	0
„ Balance on hand, Petty Cash				33	12	6
				£9,800	6	10

	£	s.	d.	£	s.	d.
To Balance at Bank 13th November, 1896:—						
General Account	921	12	4			
Scientific Relief Fund	564	4	8			
Fee Reduction Fund Account	92	11	10	1,661	8	7
Joule Memorial Fund Account	82	19	9			
„ Scientific Relief Fund, Dividends, &c.	669	18	0			
„ Donation Fund, Dividends, Transfer from Jodrell Fund, &c.	437	1	11			
„ Rumford Fund, Dividends	62	18	4			
„ Bakerian and Copley Medal Fund, Dividends	54	1	4			
„ Keck Bequest, Dividends	23	4	0			
„ Wintringham Fund, Dividends	31	18	0			
„ Croonian Lecture Fund, Rent	50	5	4			
„ Davy Medal Fund, Dividends	31	18	0	2,762	16	9
„ Gassiot Trust, Dividends	457	7	0			
„ Handley Fund, Dividends	185	10	4			
„ Jodrell Fund, Dividends	137	15	8			
„ Fee Reduction Fund, Dividends	439	16	6			
„ Darwin Medal Fund, Dividends	96	13	4			
„ Joule Memorial Fund, Dividends, &c.	49	10	0			
„ Brady Library Account, Dividends	7	9	0			
„ Gunning Fund, Interest	20	0	0			
„ Buchanan Medal Fund, Dividends	7	10	0			
				£4,424	5	4

	£	s.	d.	£	s.	d.
By Scientific Relief Fund, Grants	567	0	0			
„ Donation Fund, Grants	85	0	0			
„ Rumford Fund, Medals	116	19	1			
„ Bakerian and Copley Medal Fund, Medal, Lecture, and Gift	58	12	9			
„ Keck Bequest, Payment to Foreign Secretary	23	4	0			
„ Wintringham Fund, Payment to Foundling Hospital	32	18	11			
„ Croonian Lecture Fund Payments	50	0	0			
„ Davy Medal Fund, Medals	32	15	3			
„ Gassiot Trust, Payments to Kew Committee	459	0	7	2,320	14	1
„ Handley Fund, Transfer to General Account, for Catalogue	185	10	4			
„ Jodrell Fund, Transfer to Donation Fund	137	15	8			
„ Fee Reduction Fund, Transfer to Royal Society General Account	370	0	0			
„ Darwin Medal Fund, Medal and Gift	100	7	6			
„ Joule Memorial Fund, Studentship	100	0	0			
„ Brady Library Fund, Purchase of Book	1	10	0			
„ Balance at Bankers:—						
General Account	1,241	10	6			
Scientific Relief Fund Account	667	2	8			
Fee Reduction Fund Account	162	8	4	2,103	11	3
Joule Memorial Fund Account	32	9	9			
				£4,424	5	4

Estates and Property of the Royal Society, including Trust Funds.

Estate at Mablethorpe, Lincolnshire (55A. 2R. 2P.), rent £75 per annum.

Ground Rent of House, No. 57, Basinghall Street, rent £380 per annum.

„ „ of 23 houses in Wharton Road, West Kensington, rents £253 per annum.

Fee Farm Rent, near Lewes, Sussex, £19 4*s.* per annum.

One-fifth of the clear rent of an estate at Lambeth Hill, from the College of Physicians, about £52 per annum, Croonian Lecture Fund.

Stevenson Bequest. Chancery Dividend. One-fourth annual interest on balance of Bequest still in Court. (This year, £35 3*s.* 4*d.*)

£15,200 Mortgage Loan, 3½ per Cent., to the Duke of Norfolk.

£14,714 10*s.* 11*d.*, 2¾ per Cent. Consolidated Stock — being £11,196 10*s.* 8*d.* on account of the following Funds:—

	£	*s.*	*d.*
Rumford Fund	2,367	2	6
Wintringham Fund	1,200	0	0
Gassiot Trust	500	0	0
Sir J. Copley Fund	1,666	13	4
Jodrell Fund	5,182	14	10
Brady Library Fund	280	0	0

and £3,518 0*s.* 3*d.* in Chancery, arising from sale of the Coleman Street Estate.—General Purposes.

£1,251 8*s.* 10*d.* 2½ per Cent. Annuities —
£800 0*s.* 0*d.* Scientific Relief Fund.
£403 9*s.* 8*d.* Bakerian and Copley Medal Fund.
£47 19*s.* 2*d.* Joule Memorial Fund.

£3,000 India 3½ per Cent. Stock.—General Purposes

£1,300 India 3 per Cent. Stock.—General Purposes (Earl of Derby's Bequest).

£800 Midland Railway 3 per Cent. Debenture Stock.—Keck Bequest.

£370 3*s.* 7*d.* Midland Railway 4 per Cent. Perpetual Guaranteed Preference Stock.— General Purposes (Stevenson Bequest).

£5,660 Madras Railway Guaranteed 5 per Cent. Stock —
General Purposes, £5,000.
Davy Medal Fund, £660.

£10,000 Italian Irrigation (Cavour Canal) Bonds.—The Gassiot Trust.

£9,061 6*s.* 8*d.* Great Northern Railway 3 per Cent. Debenture Stock { Scientific Relief Fund, £7,200. / The Trevelyan Bequest, £1,861 6*s.* 8*d.*

£5,030 Great Northern Railway Perpetual 4 per Cent. Guaranteed Stock.—Donation Fund.

£2,725 „ „ „ 4 per Cent. Perpetual Preference Stock.—General Purposes (Stevenson Bequest).

£5,000 Metropolitan 3½ per Cent. Stock.—Fee Reduction Fund.

£258 9*s.* 2*d.* Metropolitan 3 per Cent. Stock—Buchanan Medal Fund.

£9,333 London and North Western Railway 3 per Cent. Perpetual Debenture Stock.—Fee Reduction Fund.

£20,908 „ „ „ „ 4 per Cent. Consolidated Guaranteed Stock.— { £6,000 Scientific Relief Fund. / £12,150 General Purposes. / £2,758 „ „ (Stevenson Bequest).

£5,000 „ „ „ „ Consolidated 4 per Cent. Preference Stock.—General Purposes.

£5,000 North Eastern Railway 4 per Cent. Preference Stock.—General Purposes.

£2,760 „ „ „ Consolidated 4 per Cent. Guaranteed Stock.—General Purposes (Stevenson Bequest).

£2,500 South Eastern Railway 4 per Cent. Debenture Stock.—Darwin Medal Fund.

£4,340 South Eastern Railway 5 per Cent. Debenture Stock.—Scientific Relief Fund.

£3,333 London and South Western Railway 4 per Cent. Preference Stock.—General Purposes.

£4,798 Lancashire and Yorkshire Railway 4 per Cent. Guaranteed Stock.—Handley Fund.

£1,000 London, Brighton, and South Coast Railway Consolidated Guaranteed 5 per Cent. Stock.—Joule Memorial Fund.

£4,000 Southern Mahratta Railway 4 per Cent. Debenture Stock.—General Purposes.

£1,000 on Deposit Account at Bank, Dr. Ludwig Mond's Gift.—Catalogue Account.

£1,000 Policy in the Atlas Assurance Office, becoming due October 7th, 1899, No. 24644.—Catalogue Account.

£1,000 Bond.—Dr. Gunning.—Interest to be applied to the promotion of Physics and Biology.

JOHN EVANS, *Treasurer.*

We, the Auditors of the Treasurer's Accounts on the part of the Council, have examined these Accounts and found them correct.

M. FOSTER.
P. A. MACMAHON.
RAPHAEL MELDOLA.

We, the Auditors of the Treasurer's Accounts on the part of the Society, have examined these Accounts and found them correct.

DOUGLAS GALTON.
HORACE BROWN.
T. E. THORPE.

Trust Funds. 1897.

Scientific Relief Fund.

£6,000 L. & N.W.R. 4 per Cent. Consolidated Guaranteed Stock.
£7,200 Great Northern Railway 3 per Cent. Debenture Stock.
£4,340 South Eastern Railway 5 per Cent. Debenture Stock.
£800 2½ per Cent. Annuities.

Dr.

	£ s. d.	£ s. d.
To Balance, Income	1,450 2 6	
Less Capital over Invested	885 17 10	564 4 8
„ Dividends		669 18 0
		£1,234 2 8

Cr.

	£ s. d.	£ s. d.
By Grants		567 0 0
„ Balance, Income	1,553 0 6	
Less Capital over Invested	885 17 10	667 2 8
		£1,234 2 8

Donation Fund.

£5,030 Great Northern Railway Perpetual 4 per Cent. Guaranteed Stock.

The Trevelyan Bequest. £1,861 6*s.* 8*d.* Great Northern Railway 3 per Cent. Debenture Stock.

	£ s. d.
To Balance	262 3 1
„ Dividends	248 9 8
„ Transfer from Jodrell Fund	137 15 8
„ Grants refunded	50 16 7
	£699 5 0

	£ s. d.
By Grants	85 0 0
„ Balance	614 5 0
	£699 5 0

Rumford Fund.

£2,367 2*s.* 6*d.* 2¾ per Cent. Consolidated Stock.

	£	*s.*	*d.*		£	*s.*	*d.*
To Balance	114	1	4	By Gold and Silver Medals	116	19	1
„ Dividends	62	18	4	„ Balance	60	0	7
	£176	19	8		£176	19	8

Bakerian and Copley Medal Fund.

Sir Joseph Copley's Gift. £1,666 13*s.* 4*d.* 2¾ per Cent. Consolidated Stock.

£403 9*s.* 8*d.* 2½ per Cent. Annuities.

	£	*s.*	*d.*		£	*s.*	*d.*
To Balance	105	17	8	By Gold Medal	4	12	9
„ Dividends, New 2½ per Cent. Stock	9	15	0	„ Bakerian Lecture, Prof. O. Reynolds and Mr. Moorby	4	0	0
„ Dividend—Sir J. Copley's Fund	44	6	4	„ Gift:—Prof. C. Gegenbaur	50	0	0
				„ Balance	101	6	3
	£159	19	0		£159	19	0

The Keck Bequest.

£800 Midland Railway 3 per Cent. Debenture Stock.

	£	*s.*	*d.*		£	*s.*	*d.*
To Dividends	23	4	0	By Payment to Foreign Secretary	23	4	0
	£23	4	0		£23	4	0

Wintringham Fund.

£1,200 2¾ per Cent. Consolidated Stock.

	£	s.	d.		£	s.	d.
To Balance	32	18	11	By Payment to Foundling Hospital	32	18	11
„ Dividends	31	18	0	„ Balance	31	18	0
	£64	16	11		£64	16	11

Croonian Lecture Fund.

One-fifth of the clear rent of an Estate at Lambeth Hill, from the College of Physicians, about £52 per annum.

	£	s.	d.		£	s.	d.
To Balance	4	4	3	By Lecture (1897), Prof. Sherrington	50	0	0
„ Rent	50	5	4	„ Balance	4	9	7
	£54	9	7		£54	9	7

Davy Medal Fund.

£660 Madras Railway Guaranteed 5 per Cent. Stock.

	£	s.	d.		£	s.	d.
To Balance	51	6	3	By Gold and Silver Medals	32	15	3
„ Dividends	31	18	0	„ Balance	50	9	0
	£83	4	3		£83	4	3

The Gassiot Trust.

£10,000 Italian Irrigation Bonds.
£500 2¾ per Cent. Consolidated Stock.

	£	s.	d.		£	s.	d.
To Balance	102	18	3	By Payments to Kew Committee	459	0	7
„ Dividends	457	7	0	„ Balance	101	4	8
	£560	5	3		£560	5	3

Handley Fund.

£4,798 Lancashire and Yorkshire Railway 4 per Cent. Guaranteed Stock.

	£ s. d.		£ s. d.
To Dividends	185 10 4	By Transfer to Catalogue Account	185 10 4
	£185 10 4		£185 10 4

The Jodrell Fund.

£5,182 14*s.* 10*d.* 2¾ per Cent. Consolidated Stock.

	£ s. d.		£ s. d.
To Dividends	137 15 8	By Transfer to Donation Fund	137 15 8
	£137 15 8		£137 15 8

Fee Reduction Fund.

£5,000 Metropolitan 3½ per Cent. Stock.
£9,333 London and North Western Railway 3 per Cent. Perpetual Debenture Stock.

	£ s. d.		£ s. d.
To Balance	92 11 10	By Transfer to Royal Society General Account	370 0 0
„ Dividends	439 16 6	„ Balance	162 8 4
	£532 8 4		£532 8 4

Darwin Medal Fund.

£2,500 South Eastern Railway 4 per Cent. Debenture Stock.

	£ s. d.		£ s. d.
To Balance	117 10 3	By Expenses, Producing Medal	0 7 6
„ Dividends	96 13 4	„ Gift: Prof. G. B. Grassi	100 0 0
		„ Balance	113 16 1
	£214 3 7		£214 3 7

Joule Memorial Fund.

£1,000 London, Brighton, and South Coast Railway Consolidated Guaranteed 5 per Cent. Stock.
£47 19*s.* 2*d.* 2½ per cent. Annuities.

	£	*s.*	*d.*		£	*s.*	*d.*
To Balance	82	19	9	By Studentship, M. Perrin, per Acad. des Sciences	100	0	0
„ Dividends, &c.	49	10	0	„ Balance	32	9	9
	£132	9	9		£132	9	9

Brady Library Fund.

£280 2¾ per Cent. Consolidated Stock.

	£	*s.*	*d.*		£	*s.*	*d.*
To Balance	33	14	10	By Purchase of Book	1	10	0
„ Dividends	7	9	0	„ Balance	39	13	10
	£41	3	10		£41	3	10

Gunning Fund.

£1,000 4 per Cent. Bond of His Excellency Dr. Gunning.

	£	*s.*	*d.*		£	*s.*	*d.*
To Balance	80	0	0	By Balance	100	0	0
„ Interest	20	0	0				
	£100	0	0		£100	0	0

Buchanan Medal Fund.

£258 9*s.* 2*d.* Metropolitan 3 per Cent. Stock.

	£	*s.*	*d.*		£	*s.*	*d.*
To Balance	16	17	6	By Balance	24	7	6
„ Dividends	7	10	0				
	£24	7	6		£24	7	6

Income and Expenditure Account from 13th November, 1896, to 12th November, 1897.

RECEIPTS.	£ s. d.	£ s. d.
To Balance at Bank and in hand 13th November, 1896 :—		
General Purposes		251 9 11
„ Coral-boring Committee, Loan Repaid		300 0 0
„ Composition and Admission Fees		190 0 0
„ Annual Contributions		1,431 0 0
„ Rents		653 0 1
„ Dividends and Interest		2,501 6 6
„ Publication Sales		757 0 9
„ Ditto Transferred from Publication Grant		80 0 0
„ Receipts on Account of Catalogue		203 19 11
„ Mr. A. Beit's Gift for Tsetse Fly Inquiry		200 0 0
„ Transfer from Dr. Ludwig Mond's Gift on account of Catalogue		324 3 11
„ Overdraft at Bankers	378 2 0	
Less Petty Cash in hand	33 12 6	
		344 9 6
		£7,236 10 7

EXPENDITURE.	£ s. d.	£ s. d.
By Salaries and Wages		1,707 4 0
„ Publications		2,931 17 3
„ Catalogue of Scientific Papers	559 12 6	
Index to ditto	290 10 6	
		850 3 0
„ Books for the Library		307 1 4
„ Miscellaneous Expenses, Office, House, Receptions, &c.		1,141 6 7
„ International Catalogue		59 17 6
„ Tsetse Fly Account Payments		121 16 9
„ Ditto Report Payments		117 4 2
		£7,236 10 7

The following Table shows the progress and present state of the Society with respect to the number of Fellows:—

	Patron and Royal.	Foreign.	Compounders.	£4 yearly.	£3 yearly.	Total.
Nov 30, 1896 ..	4	45	138	102	209	498
Since Elected ..		+10	+ 3	+ 1	+ 12	+ 26
Since Deceased ..		− 6	− 5	− 7	− 4	− 22
Nov. 30, 1897 ..	4	49	136	96	217	502

Account of Grants from the Donation Fund in 1896–97.

	£	s.	d.
Dr. H. Hicks, towards the expenses of the Rev. G. C. H. Pollen's Excavations of a Cavern at Tremeirchion, North Wales	15	0	0
Lord Lister, for the Assistance of Dr. Copeman in his Researches on Variola and Vaccinia	50	0	0
Mr. W. B. Hardy, for the Investigation of the Microchemical Reactions of the Photogenic Granules of the Glow-worm and of various Marine Animals	20	0	0
	£85	0	0

Account of the Appropriation of the Sum of £4,000 (the Government Grant) annually voted by Parliament for Scientific Investigations (continued from the 'Proceedings,' vol. 57, p. 499).

April 1, 1895, to March 31, 1896.

	£	s.	d.
A. M. W. Downing, for Continuation of the Computations for a new Edition of Taylor's Madras Star Catalogue	100	0	0
A. E. Tutton, for Accessories to his Improved Horizontal Goniometer.....	35	0	0
Carried forward.....	£135	0	0

	£	s.	d.
Brought forward	135	0	0
E. O. Walker, for the Observation and Study of Variation during the Day of the Sign and Amount of Atmospheric Electricity and its Relation to that of Atmospheric Pressure and Temperature	40	0	0
Rev. Dr. Kerr, for a Research on a New Method of examining Solid Dielectrics in Electro-optics, and for completion of an Optical Inquiry upon the question of the Polarisation of Sky Light.....	50	0	0
Prof. A. M. Worthington, for Further Inquiry into the Properties of Liquids under Tension	20	0	0
J. B. Henderson, for a Research on the Influence of Magnetic Fields and Temperature on the Electric Conductivity of Bismuth.....	50	0	0
H. H. Turner (for the Joint Permanent Eclipse Committee), for Observations of the Total Solar Eclipse of 1896	250	0	0
Incorporated Kew Committee (per C. Chree), for an Investigation of the Trustworthiness of Platinum (Electrical Resistance) Thermometers as Standards of Reference over a Long Period (1) at Low Temperatures; (2) at Fluctuating Temperatures	100	0	0
Prof. Lodge, for Continuation of Researches on the Connection between Ether and Matter	150	0	0
W. C. W. Thiel, for the Investigation of the Viscosity of Solutions, especially of Solutions which are not Electrolytes.....	20	0	0
A. Griffiths, for Determining to a High Degree of Accuracy the Coefficients of Diffusion for Solutions of Various Strengths and at Various Temperatures.....	25	0	0
W. F. Denning, for the Work of Sweeping for Comets of Short Period	30	0	0
E. Ristori and W. Macnab, for a Research on the Actual Temperature reached when various Explosives are exploded	100	0	0
W. P. Bloxam, for the Purchase of Apparatus required for Investigation of Properties of the Sulphides and Polysulphides of Potassium and Sodium	25	0	0
Sydney Young, for a Continuation of the Research on the Vapour Pressures, Specific Volume, and Critical Constants of Various Substances.....	40	0	0
Carried forward.....	£1035	0	0

	£	s.	d.
Brought forward.....	1035	0	0
Dr. Japp, to supplement a Balance of £50 remaining from a former Grant, for further Investigation of the Reactions of Ketones, Diketones, and Allied Compounds.....	25	0	0
Henry A. Miers, to defray Cost of Micrometer Eyepiece to be used in a Research upon the Irregularities in the Angles of Crystals.....	3	16	0
H. J. H. Fenton, for a Research on the Oxidisation of Tartaric Acid in presence of Iron.....	25	0	0
V. H. Veley and J. J. Manley, for an Investigation of the Electric Conductivity of Nitric Acid.....	30	0	0
F. H. Neville and C. T. Heycock, for Continuation of Experiments on Solutions of Metals at High Temperatures.....	30	0	0
Dr. S. B. Schryver, for a Research on the Oxidation of Turpentine Oil and Allied Subjects.....	26	0	0
Dr. W. H. Perkin, Jun., for Further Experiments on the Constitution of Camphoric, Sulpho-camphylic, Camphoronic, and Allied Acids, and other Researches	65	0	0
J. N. Collie, for the Production of Pyridine Compounds from Lutidine, Dihydroxypicoline, and Pseudolutidostyril.....	20	0	0
E. C. Baly, for Continuation of a Research on the Two Spectra of Rarefied Oxygen and Nitrogen.....	30	0	0
Prof. P. F. Frankland, for a Research on the Connection between Optical Activity and Chemical Constitution.....	150	0	0
G. J. Fowler, for an Investigation of the Relative Stability of the Oxides of Nitrogen.....	30	0	0
Dr. Armstrong, for a Research on the Relation between Colour and Constitution.....	150	0	0
W. P. Wynne; for payment of an Assistant in a Research on the Physical Properties of the Isomeric Monochloro- and Dichloro-benzenes and Toluenes....	50	0	0
C. Davison, for the Investigation of British Earthquakes.....	50	0	0
Prof. A. C. Haddon (for Cambridge University Committee for the Ethnographical Survey of East Anglia), for an Ethnographical Survey of East Anglia.....	25	0	0
Sir A. Geikie, for the preparation and Publication of a Geological Map of Europe, under the Authority of the International Geological Congress.....	80	0	0
Carried forward.....	£1824	16	0

	£	s.	d.
Brought forward.....	1824	16	0
Dr. Forsyth-Major and Dr. Woodward, for further Palæontological Research in Madagascar	100	0	0
G. Brebner, for a Research on the Life-histories of the Floridæ and Phæophyceæ	100	0	0
F. F. Blackman, for Apparatus to be employed in an Investigation on Assimilation and Respiration of Plants	15	0	0
Sandwich Islands Committee (per Dr. Sharp) for Completing the Investigation of the Fauna of the Sandwich Islands	200	0	0
E. J. Allen, for Boat-hire in Connection with a Systematic Investigation of the Fauna and Flora of the Outlying Grounds between the Eddystone Rocks and Start Point	100	0	0
W. E. Collinge, for a Systematic Investigation upon the Cranial Nerves and Sensory Canal System of Fishes	25	0	0
F. E. Beddard, for Payment of a Collector to accompany a West African Expedition	15	0	0
J. E. S. Moore, for an Investigation of the Freshwater Fauna of Lake Tanganyika	200	0	0
R. Assheton, for a Comparative Study of the Earliest Stages in the Formation of the Placenta of Mammals..	50	0	0
Prof. Weldon, for the Committee for conducting Statistical Investigations into the Measurable Characteristics of Plants and Animals	50	0	0
A. Willey, for a Research on the Development and Life-history of the Pearly Nautilus	200	0	0
J. W. Washbourne, for a Research on Immunity towards the Pneumococcus.....	30	0	0
Dr. Halliburton, for Continuation of Researches on Nucleoalbumins and on Proteids of Red Blood Corpuscles	50	0	0
W. G. Spencer and Dr. Risien Russell, for Research on the Correlation of the Respiratory and Laryngeal Nervous Mechanism.....	75	0	0
Dr. Gustav Mann, for Experiments on the Physiology of the Nerve Cell, and the Changes it undergoes during Activity, and as the result of Fasting	25	0	0
E. H. Starling, for Researches on (1) Absorption from the Connective Tissues ; (2) Action of various Poisons on Lymph Production in the Limbs; (3) The Innervation (?) of the Coronary Vessels	50	0	0
Dr. J. B. Leathes, for a Research on the Laws which determine the Absorption of Fluids from the Serous Cavities, &c.	25	0	0
Carried forward.....	£3134	16	0

	£	s.	d.
Brought forward.....	3134	16	0
W. M. Bayliss, for Continuation of a Research on the Vaso-dilator Centre and Vaso-dilator Reflexes in general	40	0	0
Dr. C. S. Sherrington, for Further Investigation into the Topography of the Physiological Centres in the Spinal Cord.....	75	0	0
Dr. A. E. Garrod, for Further Researches on (1) the Pigments present in Serum and Serous Exudations; (2) the Pigments of the Urine	15	0	0
Prof. Dunstan and Dr. Cash, for a Research on the Physiological Action of certain Derivatives of Aconitine of Ascertained Constitution.....	200	0	0
Dr. J. S. R. Russell, for Further Researches on Red and White Muscle.....	10	0	0
F. G. Hopkins, for Further Investigation of the Connection between Certain Physiological Pigments and Excretory Substances	5	0	0
Dr. Leonard Hill, for a Research on Intracranial Pressure	50	0	0
B. Moore, for a Research on Tissue Change after Removal of Glandular Organs.....	75	0	0
A. Buchan, to aid Discussion of Observations made at the Ben Nevis Observatories	100	0	0
Prof. Hartley, for Researches on Flame-Spectra at High Temperatures	100	0	0
Coral Reef Committee, in Aid of an Expedition to bore a Coral Reef	270	0	0
Prof. J. R. Green, for the Purchase of a Quartz Prism and necessary adjuncts to aid his Researches	15	0	0
	£4089	16	0

RECEIPTS AND EXPENDITURE ACCOUNT.

1895–96.

GENERAL FUND.

Dr. *Cr.*

	£	s.	d.		£	s.	d.
To Balance, April 1, 1895.	810	5	3	By Appropriations.....	4,089	16	0
„ Parliamentary Grant..	4,000	0	0	„ Salaries, Printing, Postage, Advertising, and other Administrative Expenses...	119	4	3
„ Repayments	79	16	8	„ Transferred to Reserve Fund	500	0	0
„ Interest on Deposit....	11	19	6	„ Balance, Mar. 31, 1896	193	1	2
	£4,902	1	5		£4,902	1	5

RESERVE FUND.

Dr.	£	*s.*	*d.*		£	*s.*	*d.* *Cr.*
To Balance, April 1, 1895	1,500	0	0	By Balance, Mar. 31, 1896	2,000	0	0
„ Transfer from General Fund.....	500	0	0				
	£2,000	0	0		£2,000	0	0

April 1, 1896, to March 31, 1897.

	£	*s.*	*d.*
Prof. G. H. Darwin, for Payment of Computers in an Investigation of the Problem of the Three Bodies—Periodic Orbits	100	0	0
Prof. J. Chunder Bose, for a Systematic Determination of the Index of Refraction of all Dielectrics for the Electric Ray by Method of Total Reflection; and other Researches	15	0	0
Prof. H. H. Turner, for the Measurement and Reduction of the Plates for the Astrographic Chart taken at the University Observatory, Oxford	150	0	0
E. D. Fridlander, for a Photographic Examination of the Effects of Dust upon Violet and Ultra-violet Light	45	0	0
Prof. G. M. Minchin, for the Measurement of Stellar Radiation by means of the Electromotive Force generated by Radiation in Photo-electric Cells	12	0	0
Prof. O. J. Lodge, for Further Research into the Modes of Connection between Matter and Ether.....	150	0	0
S. Shaw, for the Determination of the Amount of Dust suspended in the Air of the Workings of certain Coal Mines	25	0	0
W. F. Denning, for Further Search for Comets and particularly for Comets of Short Period (£20 *personal*)	30	0	0
Dr. T. Ewan, for Measurement of the Heats of Dilution of Non-electrolytes in solution and of some Electrolytes	20	0	0
C. A. Bell, to measure the Velocity of Sound in a large number of Liquids and Solutions, and thence to deduce Coefficients of Adiabatic Compressibility.....	50	0	0
J. Milne, for establishing at Carisbrooke a Recorder of Earthquakes whose Origin is at a Great Distance ..	100	0	0
Prof. W. H. Perkin, jun., for the Continued Investigation of Camphoric Acid and its Derivatives	100	0	0
Carried forward.....	£797	0	0

	£	*s.*	*d.*
Brought forward.....	797	0	0
A. E. Tutton, for a Continuation of Research on the Connection between the Atomic Weight of Contained Metals, and the Crystallographical Characters of Isomorphous Salts	75	0	0
Prof. H. B. Dixon, for a Research on the Nature of the "Explosion Wave" in Different Gases, and the Effect of Different Combustible Mixtures on the Burning of Dry Carbonic Oxide and Oxygen	100	0	0
E. B Cockburn, for the Investigation of Fenchene, its Oxidation, &c., and of various points in the Chemistry of Fenchon and its Alcohol.....	10	0	0
F. S. Kipping, for Further Investigation of Cycloid Ketones	60	0	0
Prof. P. F. Frankland, for Further Investigation on the Connection between Optical Activity and Chemical Composition	130	0	0
C. F. Cross, for Further Research on the Carbohydrates of Cereal Straws	100	0	0
Prof. Japp, for Further Investigation of the Reactions of Ketones, Diketones, and Allied Compounds ..	75	0	0
Profs. Dunstan and Cash, for Further Investigation of the Chemical Composition, Properties, and Physiological Action of the Principal Alkaloids contained in certain Aconites.....	100	0	0
Prof. Dunstan, for a Research on the Chemistry of Ricine; the Poisonous Proteid contained in Croton Oil and Castor Oil Seeds	50	0	0
T. A. Henry, for a Research on the Nature and Relationship of the several Constituents of the Drug Podophyllum	30	0	0
Sir W. M. Conway, for the Exploration of the Interior of Spitzbergen	100	0	0
P. Lake, for a Comparison of the Trilobites of the British Isles with those of other Countries	100	0	0
A. C. Seward, for Preparation of a Monograph on British Fossil Cycads, to be published by the Palæontographical Society	50	0	0
Dr. W. Hind, for Specimens and Books to be used in Preparation of a Monograph on the Lamellibranchs of the British Carboniferous Rocks.....	25	0	0
Carried forward..... ..	£1802	0	0

	£	*s.*	*d.*
Brought forward.....	1802	0	0
Dr. Woodward (for Dr. Forsyth-Major), for the Investigation of the Fossil and Recent Vertebrate Fauna of Madagascar	200	0	0
G. Brebner, for the Investigation of the Life-histories of the Genera of certain Brown and Red Sea-weeds ..	120	0	0
J. E. S. Moore, for an Investigation of the Fresh-water Fauna of Lake Tanganyika	200	0	0
E. J. Allen, to extend the Systematic Investigation of the Fauna and Flora of the Outlying Grounds to the Westward, from the Eddystone to Dodman Point..	50	0	0
A Committee (per F. W. Gamble), for Further Investigation into the Invertebrate Fauna of the Coast of Kerry	50	0	0
The Buchan Field Club (J. F. Tocher, Secretary), for a Complete Survey of the Anthropological Characteristics of the Inhabitants of Buchan, or East Aberdeenshire	15	0	0
Dublin Anthropometric Committee (per Prof. D. J. Cunningham), for Clerical Labour in working up the Results of Anthropometric Observations on 500 Individuals	20	0	0
P. C. Mitchell, for a Research on the Relations between Variation and Natural and Artificial Selection in Pigeons	20	0	0
O. H. Latter, for an Inquiry into (1) the Process of Digestion in certain Vegetable-eating Invertebrates, (2) the Changes experienced by Silk in passing from the "Silk-glands" into the Air	10	0	0
Dr. L. Hill, for Further Researches on the Pathology of Cerebral Compression	40	0	0
S. Vincent, for a Research on the Comparative Anatomy and Histology of the Supra-renal Capsules and of some other "Ductless Glands"	10	0	0
J. L. Smith, for an Investigation into the Relation of Oxygen to certain Pathological Processes.....	40	0	0
Dr. E. H. Starling, for further Research on the Mechanism of Absorption of Fluids from Connective Tissue Spaces and Serous Cavities.....	50	0	0
C. J. Martin, for a Research on the General Relation between the Toxins and Antitoxins of Serum	50	0	0
Carried forward.....	£2677	0	0

	£	s.	d.
Brought forward.....	2677	0	0
A. Brown, for (1) an Investigation into the Structural Changes that occur in the Alimentary Canal of the Salmon during the Spawning Period, (2) a Comparative Study of the Gastric Glands of Various Vertebrates ..	10	0	0
Prof. W. D. Halliburton, for Continuation of Researches on Proteids and Coagulation	60	0	0
B. Moore, for Continuation of Researches on the Physiology of the "Ductless Glands"	75	0	0
Dr. J. S. R. Russell, for a Continuation of Research in Connection with Red, White, and Degenerated Muscle.....	30	0	0
T. Gregor-Brodie, for a Research on the Nucleo-proteids obtained from Different Organs, and the Part they play in Blood-coagulation	30	0	0
Dr. A. E. Garrod, in Aid of his Researches on the Pigments of Urine	15	0	0
The Tsetse Fly Committee, for the purpose of its Investigations into the Tsetse Fly Disease	200	0	0
	£3,097	0	0

RESERVE FUND.

	£	s.	d.
The Treasurer of the Royal Society (for the Coral Reef Committee), for the Exploration of a Coral Reef in the Pacific Ocean by means of a Deep Boring.....	800	0	0
Prof. H. H. Turner (for Joint Permanent Eclipse Committee), for Observations of the Total Solar Eclipse of 1896	1,000	0	0
	£1,800	0	0

RECEIPTS AND EXPENDITURE ACCOUNT.

1896-97.

GENERAL FUND.

Dr. *Cr.*

	£	s.	d.		£	s.	d.
To Balance, April 1, 1896	193	1	2	By Appropriations.....	3,097	0	0
„ Parliamentary Grant.	4,000	0	0	„ Salaries, Printing, Postage, Advertising, and other Administrative Expenses ...	117	12	6
„ Repayments	91	0	10	„ Transferred to Reserve Fund.....	691	1	2
„ Interest on Deposit ..	15	19	11	„ Balance, Mar. 31, 1897	394	8	3
	£4,300	1	11		£4,300	1	11

RESERVE FUND.

Dr.	£	*s.*	*d.*		£	*s.*	*d.*	*Cr.*
To Balance, April 1, 1896.	2,000	0	0	By Appropriations.....	1,800	0	0	
„ Transfer from General Fund	691	1	2	„ Balance, Mar. 31, 1897	891	1	2	
	£2,691	1	2		£2,691	1	2	

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REPORTS BY MESSRS. STEPHENS AND CHRISTOPHERS.

"The Occurrence of Blackwater Fever in India." By J. W. W. STEPHENS, M.D., Cantab., and S. R. CHRISTOPHERS, M.B. Vict. Received October, 1901.

Much has been written on the subject of blackwater fever which has tended to obscure the subject. Especially has stress been laid, by those who deny its malarial origin, on its peculiar distribution. It is pointed out that the distribution of malaria and blackwater fever do not coincide. Thus it has been stated that "Algeria," although a deadly malarial country, presents no cases of blackwater. The following passage, however, from Kelsch and Kiener* contradicts this: "L'hæmoglobinurie n'est pas exclusivement née aux fièvres bilieuses des pays chauds. Nous avons déjà signalé son apparition assez fréquente dans les fièvres d'Algérie." Again, much stress has been laid on the supposed fact that blackwater does not occur commonly in India, though a highly malarial country, and that blackwater in India is a new disease—for it has happened that, from certain districts of India, within the last few years, some few cases of blackwater fever have been reported in the medical journals.

In reference to this it may be pointed out that the same idea was held in British Central Africa and West Africa, that the disease was of recent introduction. The French statistics for Gorée, however, sufficiently disprove this for West Africa. They embrace the period 1864—1870—

	No. of cases.	Deaths.
Fièvre bilieuse hématurique	109	35
Malaria (pernicious attacks)	89	51

To inquire personally into the prevalence of blackwater fever in particular districts would take much time, but we have ample evidence to show that blackwater fever is not an unknown disease in certain parts of India.

* 'Maladies des Pays Chauds,' p. 316.

Though no systematic inquiry has been undertaken by us, we have collected evidence which shows that blackwater fever exists in Assam, in the Duars (Bengal), in the Terai (Bengal), and in Madras, while isolated cases have occurred at widely separate places in India.

Calcutta.—One of the physicians at the Medical College informed us that he had seen 4 cases. Father and daughter (2), European (1), Eurasian (1).

The pathologist to the Military College informed us that he believed he had suffered from hæmoglobinuria twice, once in the Punjab, once in Calcutta.

One of the physicians at the Sealdah Hospital informed us that he saw one or two cases in hospital during the year.

The cases from Calcutta in all probability did not originate in Calcutta, but most probably came from outlying districts.

Barrackpore.—This is 9 miles from Calcutta. The following is an extract from the report of the medical officer in charge of the Station Hospital:—"Patient states that he has had a previous attack at Rawal Pindi, but there is no record of it. October 27, 1900. Urine blackish-red. Microscopically no blood corpuscles. On the 30th, urine nearly normal. November 1, 1900. A relapse, urine smoky black colour. Two other men in hospital also passed dark-coloured urine. In one case it was transitory. In the other case it was very persistent and continued for weeks. The patient had an enlarged spleen, and the typical appearance of malarial cachexia. I put him upon quinine and it stopped the fever and the hæmoglobinuria. He was free from both for several weeks, when again he got an attack of fever accompanied by urine of smoky black colour. I do not think this condition can be so uncommon as is generally stated. It is certain that it can be easily overlooked, it is in fact impossible to detect it unless the urine is collected in a vessel, which is the exception. I noticed one case in hospital in 1899 and another in a private patient."

Hazaribagh.—Captain Maynard reports a case.

Meerut.—A case has been reported from here.

Roorkee.—Station Hospital, 1900. There was an admission for hæmoglobinuria. The disease was of the intermittent type. The urine passed was blood coloured. Under the microscope no blood cells were detected.

Statistic of the Army and Prisoners in India.

The Principal Medical Officer of His Majesty's forces in India informed us that he had had blackwater himself, and that it occurred in the army. It should be noted, however, in this connection, that no separate heading "Blackwater fever" occurs in the nomenclature of diseases employed, that even if recognised it is quite possible or probable that the hæmoglobinuria might be returned under the

heading "Ague" or "Remittent fever," which is the classification of malarial fever employed. It might even be returned simply as "jaundice." It may also be questioned whether some of the entries under the heading "hæmaturia" were not really cases of hæmoglobinuria. Many cases of hæmaturia appear in the statistics from 1870 onwards, but as it is impossible to say anything further about them, they have been omitted in the following table. Those of "intermittent" hæmaturia have been left in, though no certainty can attach to their interpretation.

We are much indebted to the kindness of Colonel Wilkie, I.M.S., Statistical Office, Simla, for the following table:—

Table to show presence of cases of Hæmoglobinuria in European and Native Troops.

	European troops.		Native troops.		Prisoners.	
	Intermittent hæmaturia.	Hæmoglobinuria.	Intermittent hæmaturia.	Hæmaglobinuria.	Intermittent hæmaturia.	Hæmoglobiduria.
1887.....	2	—	—	—	—	—
1888.....	—	—	—	—	—	—
1889.....	1	—	—	—	—	—
1890.....	—	—	—	—	1	—
1891.....	1	—	—	—	—	—
1892.....	—	—	—	—	—	—
1893.....	1	—	—	—	—	—
1894.....	1	—	—	—	—	—
1895.....	1	—	—	—	—	—
1896.....	2	—	—	—	2	—
1897.....	—	2	—	—	—	—
1898.....	—	—	—	—	—	—
1899.....	—	3	—	1	—	—
1900.....	—	5	—	2	—	—

(1.) Madras.—Rajahmundry Central Jail. Captain Fearnside, I.M.S., in a report on the sickness among the prisoners, writes:—"During the recent epidemic only two cases of hæmoglobinuria or blackwater fever occurred." Elsewhere* Captain Fearnside, writes:—"In 1891 I suffered for 9 months from æstivo-autumnal fever, accompanied in the last stages with blackwater fever."

(2.) Godavery Agency.—The following extract from a letter is self-explanatory:—In September, 1897, I had a very mild attack of blackwater fever in the Bhadrachelam Taluk of the Godavery

* 'Scientific Memoirs by Medical Officers of the Army of India,' Part XII, 1901.

Agency. There are cases not uncommonly in the Jeypore Agency of Vizagapatam, and more than one German missionary up there has suffered badly. . . . He is a very old resident, and has buried many of his brethren, and nursed many cases of blackwater fever."

(3.) Secunderabad.—In Secunderabad, the cantonment of Hyderabad, Southern India, in 1882–83, Lieut.-Colonel King, Sanitary Commissioner of Madras, in a private letter writes:—"I had several cases of the most intense pernicious malarial fever, and, Koch notwithstanding, these cases presented bloody urine before they had had a single dose of quinine."

Assam.

(1.) *Nowgong* (*Salonah Division*).—A tea planter writes:—"There are very few cases of blackwater fever about this district nowadays, but when I came here 23 years ago, and for many years after, there were several cases every year amongst Europeans, and many deaths."

(2.) *Silchar* (*Sylhet*).—*a.* Two cases recorded by Rev. G. G. Crosier, B.S.M.D., in the 'Indian Medical Gazette,' December, 1900.

b. Dr. A. Powell records in the 'Journal of Tropical Medicine' for December, 1898, 11 cases from this region.

c. Dr. B. Seal reports one case from Sylhet.

Bengal Terai.

Dr. B. Seal reports six cases in eight years from the Darjeeling Terai.

Inquiry among the planters and medical officers of the tea estates makes it clear that blackwater fever has been imperfectly well known to the oldest European residents. It has been recognised thus for at least 20 years in this district, but in the early days was known as "jaundice," or "bilious jaundice." There are at present but few European planters resident in the Terai. The Terai had and still has the reputation of being a most deadly fever district.

Bengal Duars.

In this district we have been able to make inquiries personally, and we describe shortly two cases we ourselves saw and two others, the blood films of which were most kindly sent to us by Dr. Cowen, of Nagrakata. Here, again, we were informed by the oldest medical officer, who had resided for 14 years in the district, that the name blackwater fever had only recently been applied to these cases—that previously he simply called them cases of jaundice or bilious fever with jaundice. This corresponds exactly to the information we gathered in British Central Africa, when in the early days of the Protectorate deaths were reported as occurring from severe jaundice with fever.

To what extent blackwater fever prevails in the district it is difficult to determine except by long residence, but we do not think we err in saying that few tea gardens in the Duars have not suffered at some time from blackwater fever.

During the short stay we were able to make there we saw two cases in one week, and four cases occurred within a fortnight. This is a number that was never encountered by us either in British Central Africa or West Africa.

The following two cases were seen by us :—

CASE XVII.—Bengal Duars. Hilda Tea Estate.

Bengalee Babu. Had fever in Assam in 1900. April, 1901. Had fever with dark urine staining his clothes reddish.

23.8.01. A little fever at night.

24.8.01. Fever with ague.

25.8.01. Midday, antifebrin and two quinine pills of four grains each. 8–9 P.M., passed urine like blood.

26.8.01. Midday, temperature 104°. 6 P.M., temperature 104°.

28.8.01. Urine began to clear.

30.8.01. No hæmoglobin in urine. Patient first seen by us. Jaundice. Hiccough. Blood films taken 6 P.M.

31.8.01. Blood films, 8 A.M. Serum very yellow, as seen on slide. Blood rather fluid. Death about midnight.

This case, then, corresponds exactly in two essential points with those we have previously reported, viz., the previous history of "fever" and the previous history of quinine.

The blood examination, as one expected at this late stage of the disease, was negative as regards parasites. The leucocytic values were as follows :—

30.8.01. 6 P.M.

700 leucocytes counted	Large mononuclears ...	15 per cent.
	Small „ ...	15 „
	Polymorphonuclears ...	69 „
	Eosinophil cells	1 „

31.8.01. 8 A.M.

700 leucocytes counted	Large mononuclears ...	16 per cent.
	Small „ ...	18·6 „
	Polymorphonuclears ...	63·6 „
	Eosinophil cells	1·6 „

The mononuclear value certainly suggests, but is not conclusive, of malarial infection.

CASE XVIII.—Bengal Duars. Ghatia Tea Estate.

Bengalee bamboo.

26–28.8.01. Slight fever.

29.8.01. Between 7–9 A.M. quinine 1 gramme. Rigor 10 A.M. Passed red urine 12.30 midday. Blood film taken 7 P.M. No parasites.

31.8.01. First seen by us. 11.30 A.M., temperature 100°. Jaundice. Serum yellow. Urine contains no hæmoglobin. Much bile pigment. (This is the first case of blackwater fever in which bile pigment has been found by us in the urine. F. Plehn also mentions the rarity of its occurrence.) Blood films = no parasites, one pigmented leucocyte.

19.0.1. Temperature 98°·6. Blood films = no parasites.

5.9.01. Death occurred.

The evidence of malaria in this case depends on the presence of a pigmented leucocyte, and the following leucocytic counts :—

29.8.01. 7 P.M.

700 leucocytes counted	Large mononuclear ...	20·5 per cent.
	Small „ ...	18·5 „
	Polymorphonuclear...	60 „
	Eosinophil	1 „

31.8.01. 11.30 A.M.

1000 leucocytes counted	Large mononuclear ...	17·6 per cent.
	Small „ ...	13·8 „
	Polymorphonuclear...	67·2 „
	Eosinophil	1·3 „

1.9.01.

700 leucocytes counted	Large mononuclear ...	18·2 per cent.
	Small „ ...	10·3 „
	Polymorphonuclear...	69·9 „
	Eosinophil	1·6 „

CASE XIX.—J.B.O. Nagrakata. Bengal Duars, India.

Said to have had B.W. in 1896. Went home in 1898. Takes large doses of quinine prophylactically and during attacks of fever. In Calcutta, November, 1901. On his return feeling out of sorts. A good deal of quinine taken.

Quinine History.—December 1, grains 15. December 4, grains 10. December 5, grains 5.

History of Illness.—December 10. Feeling ill. Symptoms of "gastritis."

December 17. 10 A.M. Quinine, grains 10. 4 P.M. Fingers numb. Feels cold. Thinks he is going to have fever. 5 P.M. Passed urine dark colour.

10.30 P.M. "Bad ague." Passed several samples of dark urine.

December 18. Went to work, but felt bad. Urine still not of "right colour."

11.30 A.M. Bad ague. 12.30 NOON. T. 101°·6. Blood films taken.
2 P.M. Brown urine. 4.30 P.M. Blood films taken.
10 P.M. Dark red urine.

December 19. 7 A.M. Urine lighter. Brown.
10.30 A.M. Shivers.
11 A.M. T. 102°. Spleen palpable. Liver tender.
12.30 NOON. Dark red urine. 6 P.M. Blood films.

December 20. 12 NOON. T. 98°·6. Blood films taken.
4 P.M. Dark red urine.
7.15 P.M. Urine normal.

No bile in any specimen of urine. No jaundice observed, but room rather dark. No quinine throughout.

Dr. Cowen, of Nagrakata, most kindly furnished us with the above notes.

Examination of blood.

18.12.01. (NOON). No parasites, no pigment.

Large mononuclear	20·3 per cent.
Small mononuclear	14·3 „
Polynuclear	64·2 „
Eosinophil	1·2 „

18.12.01. 4.30 P.M.

Large mononuclear	18·1 per cent.
Small mononuclear	22·5 „
Polynuclear	59·7 „
Eosinophil	0·8 „

20.12.01.

Large mononuclear	13·3 per cent.
Small mononuclear	24·1 „
Polynuclear	61·6 „
Eosinophil	1·0 „

Case XX.—W., æt. 26. Nagrakata, Bengal Duars arrived in India June 4, 1901. Much fever during the year. December 21, 1900, feeling out of sorts, aching in back and legs. No quinine for 6 weeks.

25.12.01. Quite well in morning. 3 P.M. Felt his hands hot, with fever. Took quinine, grains 10 in a mixture.
6 P.M. Rigors. 7.30 P.M. Vomiting, continuing all night.

26.12.01.

3 A.M. Shivers. Passed dark red urine (albuminous). Fingers numb, bloodless, and stiff.

9 A.M. Quinine, grains 10. Vomited an hour later.

10.30 A.M. Strong rigors. Vomiting, slight jaundice. Dark red urine, one-third albumen.

1 P.M. T. 103°·2. 2 P.M. Dark red urine. 3.45 P.M. Blood films.

6 P.M. T. 103°·9. Spleen extends 4 inches below ribs. Liver 1 inch. Blood films.

27.12.01.

Much jaundice, urine still red. 12 noon. Blood films. 7 P.M. Blood films.

28.12.01.

9 P.M. Urine pale brown.

29.12.01.

Urine pale yellow.

Blood examinations.

26.12.01. 3.45 P.M.

Many typical young single tertians (Romanowsky) with stippling of red cell. One pigmented large mononuclear.

Large mononuclear	23·0 per cent.
Small mononuclear	20·5 „
Polynuclear	56·0 „
Eosinophil	0·0 „

26.12.01. 6 P.M.

A single large parasite only.

Large mononuclear	18·4 per cent.
Small mononuclear	12·4 „
Polynuclear	69·2 „
Eosinophil	0·0 „

27.12.01. No parasites. No pigment.

Large mononuclear	15·75 per cent.
Small mononuclear	24·5 „
Polynuclear	59·75 „

The blood examination is of extreme interest, as showing how parasites, at first easily found, had in two hours almost completely disappeared, and did not again return in subsequent films.

The cases resembled in every respect those previously seen by us in West Africa and British Central Africa, and there can be no doubt as to the identity of the disease here and in Africa.

Evidently in the Duars blackwater fever is a distinctly common disease, much more so than in India in general. It will be of advantage

to consider what the occurrence of blackwater fever in such intensity in the Duars really signifies, and why it should be more common there than in the rest of India.

If we presume that blackwater fever is in some way dependent upon repeated, or perhaps continuous, malarial infection, the explanation is simple.

The Duars, as shown by the percentage of children infected (endemic index), by the spleen rate, and by the sporozoit rate, is a much more malarious district than the plains of Bengal. In Bengal, the endemic index has been shown by us in the places visited to vary from 0 per cent. to 7 per cent. only, whereas in the Duars it rises to 40 per cent. to 72 per cent. ("The relation of endemicity to 'species' of anopheles.") We have also seen that one species in particular of *anopheles* is confined to the Duars, and that this species is possibly the cause of the high endemicity, and hence, indirectly, of blackwater fever. We would say, then, that the reason why blackwater fever is so much more prevalent in the Duars than in the rest of India is because in the former we are dealing with a really malarious country comparable with W. Africa, whereas, in the latter, we have a country far less malarial.

The Jeypore Agency—Madras.

This is a hill district with plateaux at about 3000 feet elevation, forming practically a continuation of the Eastern Ghauts. Extending from about the 17th to the 20th parallel N., it lies about 100 miles inland from the coast line at Vizagapatam, Madras. Although we believe no record exists in official reports or medical publications of blackwater fever in this district, yet quite accidentally its existence came to our knowledge, and, further, as we failed on inquiry outside the district to obtain any information as to blackwater fever here, we determined to visit it ourselves.

We found that in the Jeypore district the number of Europeans at any time is exceedingly small. There are about ten German missionaries and an occasional official scattered throughout the district, so that at any time the total number of cases could not be large, but still among these missionaries eight or nine have suffered from blackwater since the establishment of the mission in 1882, and likewise a few cases were known among the officials. So that it is quite clear that in the Jeypore Agency we have a blackwater focus quite as distinct as that of the Duars, though for the reasons stated above the total number of cases is less. We think it possible, too, that other foci may be found in India, as for instance along the Western Ghauts.

There are, further, certain facts which, from our observations of blackwater fever in the Duars and in this district, seem to us of considerable importance.

1. We are much struck on visiting the Duars by the almost exact parallel between the conditions of life there of the European settler and those we had already seen in Africa, and here in Jeypore the conditions were repeated. The Europeans live under conditions in which an almost constant malarial infection can occur, that is, they live in the midst of native huts, and the children have an extraordinarily high malarial index—50 to 86 per cent. (in February), and, as a matter of fact, they constantly suffer from fever and are too constantly taking quinine. This is a condition very different from what prevails elsewhere in India, where the segregation of Europeans in cantonments and comparative freedom from infection is almost general.

2. We had anticipated, as our researches on blackwater had led us to conclude, that blackwater fever is only found in regions of the highest endemicity, that we should find the Jeypore district to be one of high endemicity. This was indeed so: ascending from the plains where—apparently with all the factors requisite for a high endemic index—the endemicity was 0 (Salur), in 15 miles we had reached an index of 50, Sunki (2000 feet) and at Patingi (2800 feet) it had reached 70, and at Bodawalasa (2000 feet) it was 86. We have then to take into account these remarkable variations in endemicity. We have given a parallel instance at Ennur-Madras, where within a distance of 10 miles only, with, so far as we could judge, exact identity of all conditions, there occurred a change in the endemicity from 5 to 55.

We believe that it is only under conditions of high endemicity that blackwater can appear, and at any rate it must be recognised that we cannot explain at present these variations in the malarial endemicity of adjacent districts.

3. In the Jeypore district we found a new anopheles, *A. Jeyporensis*, and *A. Christophersi* the predominant species in the Duars. We have above discussed the relation of species of anopheles to endemicity, and have said that it is at present purely a matter of conjecture whether this factor determines *virulence* of infection with a particular parasite, but this species plays a part in determining the existence of infection we think the facts brought forward by us show.

4. It is noteworthy that here and in the Duars the parasite infection in the native children was a quartan one, and there seems to be, at least in these two instances, an association between quartan infection and high endemicity. In the comparatively low endemic area of the Central provinces the infection was among the native children mainly simple tertian.

5. It is impossible to estimate the influence of climatological factors, but they certainly cannot be disregarded, (1) in their relation to the constitution of the European; (2) in the wider determination of the endemicity (and virulence) of malaria. In this respect, for instance, the Duars cannot be compared with the Punjab, nor the Congo with Algeria.

Conclusions.

1. Blackwater, so far as our present knowledge extends, is, in India, confined to the Duars and Terai (Bengal), the Jeypore Agency (Madras), and to Assam (Sylhet and Nowgong).

2. The endemic index in these regions is extremely high.

3. The endemic index of other portions of India visited by us is comparatively low.

4. The conditions of life, especially the close association with native dwellings—in the blackwater fever districts of India are almost the same as in tropical Africa.

5. The practical outcome of our investigations is that the prophylaxis of blackwater is identical with that of malaria; and in India, as in Africa, segregation of Europeans from the midst of native infection should play an important part.

"Malaria in an Indian Cantonment (Mian Mir): an Experimental Application of Anti-malarial Measures.—Preliminary Report." By J. W. W. STEPHENS, M.D. Cantab., and S. R. CHRISTOPHERS, M.B. Vict. Received February 6, 1902.

Before any practical measures are to be generally adopted against malaria, it is desirable to demonstrate by test operations that these are capable of bringing about the desired result.

Some demonstrations of the utility of anti-malarial measures have already been made:

1. Professor Koch has shown in Stephansort that under the conditions there prevailing malaria could be successfully eliminated by attacking the parasite in its human host through the careful administration of quinine.

2. Major Ross commenced in 1901 extensive operations against malaria in Freetown, Sierra Leone. His methods have been directed in the main to the destruction of *anopheles* (larvæ), and are mainly those of surface drainage and subsidiary measures directed against the breeding of mosquitoes. Already Major Ross is of the opinion that these measures have met with marked success.

3. Several years ago at Accra, Gold Coast, the residences of the officials were removed from Accra town to an unoccupied site about half a mile from any native dwellings, since called Victoriaborg. This is almost the only case we have seen where in Africa a scheme of segregation has been carried out. The result has been to make Victoriaborg reputedly the most healthy European settlement on the West Coast of Africa.

These demonstrations show that malaria has been combated by three very different methods. Apart from personal protection, preventive measures in the tropics appear to be confined to these three methods, namely:—

1. The destruction of the parasite in the human host or quinine administration.
2. The destruction of the carriers of malaria, *anopheles* or mosquito destroying operations.
3. The protection of Europeans in highly malarious countries by segregation.

The probable utility of each of these methods has always to be judged on its adaptability to the particular conditions encountered In many situations all three methods can be applied, in others only one or other is possible.

Amongst a docile or educated population quinine has been shown to succeed. In towns and in dry districts destruction of mosquitoes is likely to be the best method, and when brought about must be of all results the most desirable. In deadly malarial districts and savage countries—indeed, in almost all out stations in the jungle or bush—segregation of Europeans is the only prophylactic measure that is possible. In Africa the conditions of bush and swamp, together with swarming populations, make the diminution of native malaria obviously impossible, and hence the protection of Europeans ought to be the one and only object of first measures.

In India the European has to a large extent protected himself by living in large and isolated bungalows, together with a standard of comfort unknown in Africa. The Europeans in India who are chiefly exposed to danger of infection are soldiers in cantonments, where, as we shall see, several conditions conspire to render these centres of malaria.

In India also the high state of sanitary administration makes it likely that, on the whole, mosquito destruction will be the preventive measure most generally applicable. But in India, also in certain districts as in the Bengal Duars, the conditions approximate closely to those of an African out-station, and here, too, segregation will be the first measure of protection.

The Choice of a Cantonment.

While desiring, then, to demonstrate practically the utility of all anti-malarial measures, we wished especially to turn our chief attention to the destruction of anopheles (larvæ).

We selected a military cantonment with an exceedingly high malarial rate, and which was at the same time very dry. It was obviously inexpedient to select a site where there was much swamp, as the

drainage or filling up of this would necessarily be a matter of time, and probably considerable expense. These conditions, we thought, were furnished by Mian Mir cantonment in the Punjab. We shall see later, however, that although in a district which is so dry as almost to deserve the appellation "desert," yet there is abundant water for the breeding of anopheles.

The Conditions found at Mian Mir.

Mian Mir cantonment is situated on an extensive and level plain of alluvium, and throughout the greater part of the year is totally free from water except that of artificial supplies (irrigation channels and deep wells). The arid, sun-scorched, dust-begrimed appearance of the land is very striking, yet anopheles are very plentiful, and *anopheles'* larvæ are nearly everywhere present in the waters of the irrigation system.

Breeding Places of Anopheles.

A main canal enters the cantonment, and from this distributing channels convey water to gardens, &c., within the cantonment and in some instances to agricultural areas without. The flow in these channels is practically constant, and water is distributed as occasion demands over different pieces of ground. Here and there a shallow pool may be found, the overflow of some channel, but such pools are not many. The breeding places of *anopheles* in Mian Mir are:—

1. The medium sized canals.
2. The small distributing channels.
3. A few shallow pools and small cement tanks.
4. Earthenware fire pots, kerosine tins, and horse troughs.

The water which is distributed by means of Persian wheels over the land is negligible as a breeding ground, as the water is rapidly absorbed into the dry soil, and we have rarely detected larvæ in such water.

In the larger channels (4–6 feet wide) noted above, the flow of water is about 1·5 feet per second. In the open water of these canals larvæ do not occur. There is, however, very generally a fringe of grass or weed projecting inwards from the banks. In the shelter of this fringe, where the flow of water is impeded, anopheles larvæ are very frequently found.

In the large canals such as that bringing the water into Mian Mir, full-grown larvæ are rarely found, except where the flow of water is checked by one of the many bridges which cross the canal. There are, however, throughout the whole length many minute larvæ always present. This condition is so uniform that the conclusion is inevitable

that the eggs and young larvæ are carried down stream to develope among the grass edging the comparatively still water near the bridges.

In the small channels the growth of vegetation is often much ranker and in some water plants exist. In such channels larvæ of all sizes are generally abundant, but especially so near bazaars.

Overflow pools are generally shallow muddy puddles. If near a bazaar or native huts they generally contain many larvæ.

In the large tanks in Mian Mir we have not found larvæ. In a small cement cistern *anopheles'* larvæ were found in large numbers, as also in some horse troughs.

Both in earthenware fire pots and in paraffin tins we have found *anopheles'* larvæ.

The Species of Anopheles in Mian Mir.

Following upon our work in Bengal, we set about determining what species of *anopheles* existed in Mian Mir and what was the nature of the breeding places of each.

The following species were found by us:—

1. *A. Rossii* (Giles). The commonest mosquito.
2. *A. culicifacies* (Liston). Very common.
3. *A. Stephensi* (Liston). Not common.
4. *A. pulcherrimus* (Malaria Commission). A few adult insects only.
5. *A. Jamesii* (Liston). Rare.
6. *A. Sinensis s. sp. Nigerrimus* (Theobald). Larvæ only.

In a large series of observations the larvæ taken from the canals were all those of *A. culicifacies*. In some of the more weed-grown canals the larvæ of *A. Sinensis* also occurred. The larvæ of *A. Rossii* and *A. Stephensi* were never found by us in the canals in Mian Mir. In a slow flowing weedy canal at Meerut *A. Rossii* was present amidst innumerable *A. culicifacies*.

In the shallow muddy overflow puddles the larvæ were invariably those of *A. Rossii*. Only where the overflow was extensive and contained much weed growth were the larvæ also of *A. Jamesii* and *A. Sinensis* found.

Larvæ taken from paraffin tins and earthenware pots were always those of *A. Stephensi*.

A. pulcherrimus, which is a rare species, has not yet been found breeding by us.

We have then the same remarkable distinction between the breeding places of the species in Mian Mir that we have previously drawn attention to in Bengal.

In September and October the winged insects of *A. Rossii* were extremely abundant in nearly all the native bazaars, and in some

saddle rooms near the cavalry stables. In the barracks a few only were to be caught with difficulty.

The number of *A. culicifacies* varied considerably in the different bazaars. Though in some cases they were very abundant in the regimental bazaars, yet one or two specimens only were caught by us resting in the daytime in the barracks.

In the case of *A. culicifacies* a direct relationship seemed to hold good between the proximity of irrigation channels and the number of adult insects in the bazaar.

With *A. Rossii*, however, it was extremely difficult to trace a very close connection between the occurrence of the adult insects and the presence of breeding places. This species swarmed in nearly every native quarter, though breeding places in several cases could not be found, whilst in others the small number of larvæ seemed quite out of proportion to the large number of adult insects. Near some bazaars shallow muddy pools existed containing many thousands of larvæ. The breeding places of *A. Rossii* appear to be very evanescent in nature, consisting of shallow pools which for a week or two breed many thousands of mosquitoes, and then disappear, leaving little trace of their existence.

In November a great diminution of *A. Rossii* had taken place in many of the situations where they had a month ago swarmed.

Human Malaria in Mian Mir.

In or close to cantonments in India there generally are small native villages known as "regimental bazaars."

In Mian Mir there are several of these. They form a convenient test of the endemic index of the cantonment.

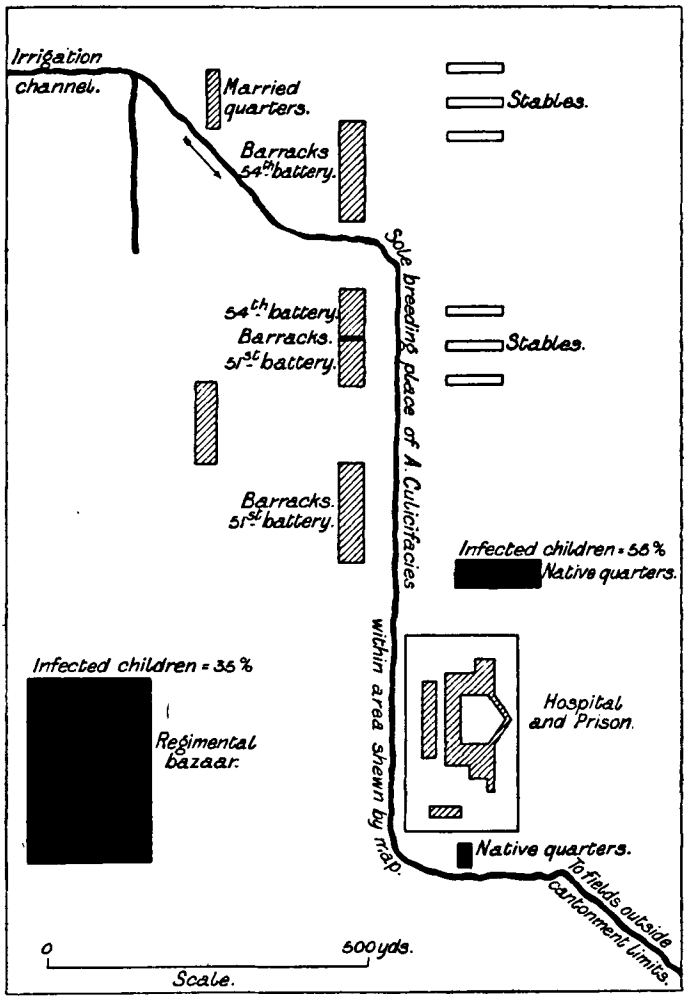
Some variations in the percentage of children infected occurred more or less dependent on the facilities for the breeding of *A. culicifacies*. Although we were unable to find (in November) in some bazaars many *anopheles*, either *A. Rossii* or *A. culicifacies*, yet the malarial index was still high. This may simply have been that *anopheles* had disappeared shortly before, as might easily be the case where *A. culicifacies* is concerned, from the cleaning of a single ditch.

The results of the examination of the children of different bazaars shows a correspondence between the proximity of ditches and the malarial index.

Table I.

That these bazaars constitute a large source of infection for the troops is undoubted. They are as it were great central depôts of anopheles and malarial parasites.

One of the Royal Artillery barracks in Mian Mir has two such native quarters close at hand (see plan).



Plan of Royal Artillery lines, showing conditions relating to the spread of malaria. Native quarters shown in solid black.

Infection among the European Troops.

A number of men of the 54th and 51st batteries of the Royal Artillery at Mian Mir were examined towards the end of November, when presumably the fever season was not at its height.

One-half of the entire strength of the 54th, and every fourth man of the 51st taken in the order in which they slept in barracks was examined.

The result of the examination was unexpected, and is shown in the following table:—

	Number of men examined.	Percentage of infection.
54th battery.....	52	17·3
51st battery	34	29·4

The hospital statistics of returns for malaria are obviously inadequate to express the real extent to which malaria prevails among the European troops. The number of cases admitted to hospital must be to a large extent only a secondary effect depending upon the presence of a hitherto unsuspected widespread "latent" infection, equal in the Royal Artillery lines in Mian Mir to nearly a third of the full strength of a battery.

Methods by which Malaria under such circumstances may best be Combated.

1. *The Test of the Reduction of Malaria.*—In any experiment which has for its object the demonstration of the utility of practical measures, careful consideration must be given to the tests of success to be employed.

The general opinion of the inhabitants of a station is far too vague to be of much value. We can, however, show that destructive measures have been successful by the following means:—

(1.) It can be made evident that though previously at the same time of year larvæ were found readily, yet in the year of the experiment they were not so abundant. If the measures adopted are successful, there ought to be no doubt as to this point.

An estimate of the ease with which larvæ are caught in the same waters in the year previous to and subsequent to destructive measures should show a well-marked and easily recognisable diminution in the latter year.

(2.) While *anopheles* can be caught in houses, probably they are abundant. The ease with which they are found depends very much upon the facilities one has for detecting them—such as the presence of rooms with low, sooty ceilings, unoccupied houses, sheds, and out-houses. In a given bazaar, however, it is possible for one who has regularly collected *anopheles* there to say with certainty that they are more or less abundant. If next year there is a well-marked decrease in one or other of the species of *anopheles* we shall be in a position to determine this fact with certainty.

(3.) Most difficult of all may be the demonstration that there is a real improvement in the health of the station. We hope, however, that by this test also the effect of a vigorous attempt to prevent *anopheles* breeding may be shown in a diminution of the following:—

1. Admissions for "ague" and "remittent fever" to the hospitals.
2. The percentage of infection among the troops.
3. The endemic index of the regimental bazaars.

In the case of hospital statistics we are dealing with an element of uncertainty, as relapses and even other fevers may be entered as fresh infections of malaria.

In order to see what proportion of cases of "ague" were really malaria, a number of men admitted to hospital as ague cases were examined.

Of these, 40 per cent. showed parasites. As many of the men had quinine before admission, we may consider that the increase in admissions for fever from June to November is really due to malaria.

It ought, then, to be possible to show *a diminished statistical return for fever and ague* in these months.

The percentage of infection among the troops is a more reliable index of the amount of malaria than the hospital returns. The percentage in the men of the Royal Artillery batteries we have seen to be 17·3 per cent. to 29·4 per cent. at the end of November, when the number of admissions for malaria are less than in the height of the fever season. If operations against malaria are successful, this high percentage of infected men ought to be much reduced.

Finally, we have a very accurate test in the endemic index (parasite rate) among the native children of the various regimental bazaars. If these show a well-marked reduction, we can fairly conclude that measures directed against *anopheles* in Mian Mir have been successful.

2. *The Prevention of Malaria in Mian Mir.*—In an accompanying report we show that in Mian Mir while *A. culicifacies* was actively carrying malaria, *A. Rossii* did not appear to be doing so.

In the bazaars the proximity to ditches and the numbers of Culicifacies seemed to influence the amount of infection, whereas the number of *A. Rossii* did not seem to have any relation to the fever rate.

Although therefore it would, in the present state of our knowledge, be advisable to keep a sharp look out against the shallow muddy pools in which *A. Rossii* breed, yet in the main our attention should be turned to the prevention of the breeding of *A. culicifacies*.

The extermination of *A. culicifacies* practically consists in some effective way of preventing *anopheles* breeding in the irrigation canals, and especially in the small irrigation channels.

It has been seen that the grassy edges give the shelter and reduced rate of flow necessary to the development of the larvæ. Some experiments were therefore made to show whether the cleaning of these edges, so that an even earth surface was given to the bank, had the effect of doing away with the larvæ.

Experiment 1.—A length of the main canal in which we had

previously detected small larvæ along the whole length was cleaned. On a second visit no larvæ were found until a portion left uncleaned was reached, when many small larvæ were present. This freedom from larvæ continued many weeks.

Experiment 2.—A channel lying close beside a regimental bazaar was cleared of all grass and weed. No larvæ were ever afterwards detected here. A canal on the other side of the bazaar, but further removed, was left in its original uncleaned condition. Here larvæ of all sizes were very abundant.

The cleaning of canals, thereby removing weed and promoting flow, therefore very much reduces, if it does not altogether prevent, the development of larvæ.

Some of the canals and channels within the cantonment are used for the supply of water to gardens; others, however, supply agricultural tracts within and even outside the cantonment.

As an example we may note an irrigation channel which passes through the Royal Artillery lines past the hospital and prison to supply some fields beyond. In this channel are many larvæ of *A. culicifacies*, and as it is almost the only source of larvæ within this area, it may be considered the cause that maintains most of the malaria among the Royal Artillery at Mian Mir.

There can be no doubt that this channel, less than a yard wide, should either be done away with, or that it should be made into a well-built brick aqueduct.

Could all irrigation channels within the limits of Mian Mir be made of brick it would enormously improve the health of the cantonment. Some at least of the channels, namely, such a one as that described, which passes within a stone's throw of three barracks, married quarters, a hospital, and a prison, ought to be done away with or made permanently unfit for the breeding of *anopheles*.

In our present experiment we hope, chiefly by the constant cleaning of canals and channels, maintained for many months, to show a definite improvement in the health of Mian Mir.

An experiment on a small scale was undertaken by cleaning the ditches around a small regimental bazaar to demonstrate a reduction of the winged insects. Unfortunately, however, the experiment, though successful, is not conclusive, as *anopheles* by this time were becoming less in other parts of the cantonment, presumably owing to the onset of the cold weather.

Although the demonstration of the possibility of prevention of the breeding of *anopheles* is the main object we have in view, yet other means of prophylaxis are so evidently applicable, that in one or more cases we shall endeavour also to put them in action.

1. The regimental bazaars have already been mentioned. In the case of the Royal Artillery barracks a collection of Syce huts is within

100 yards of the European lines. Such a state of affairs can only be looked upon as dangerous in the extreme. Even though the larger regimental bazaars cannot at once be done away with, all such small native quarters as the above-mentioned Syce lines ought to be removed without hesitation. In the instance noted there is nothing to prevent the quarter being removed half a mile or more out on to the Maidan.

2. Attention has also been called to the high degree of infection in men supposed to be in health and performing their regular duties. As in nearly every case the parasite encountered was the benign tertian, it is impossible to believe that the quinine issued at present is actually taken by the men. So far as we have been able to gather, quinine administration in institutions or to troops is only likely to be effective if quinine parades are instituted and each man made to swallow his dose in the presence of the medical officer. An active quinine administration under personal supervision would, we feel sure, enormously reduce the large latent infection found by us in the men of the Royal Artillery in Mian Mir.

"Brief Summary of Conclusions arrived at in the Previous Papers."

By J. W. W. Stephens, M.D. Cantab., and Lieut. S. R. Christophers, I.M.S., M.B. Vict.

The Malarial Infection of Europeans—Prophylaxis.

1. In tropical Africa (but perhaps to a less extent in certain regions of India) there is a widespread infection among the native children (under fifteen years of age). Above this age there is a marked immunity.

2. This infection through natives is the essential cause of European malaria, so much so that infection from one European to another may be neglected as a factor in the spread of the disease.

3. The chief source of infected *anopheles* is native huts. In fact, the true distribution of *anopheles* (at least during the dry season) is identical with that of native huts.

4. Segregation offers the most practical and immediately effective means of diminishing the death roll among Europeans.

5. Efficient protection to Europeans would be afforded by a segregation of a quarter of a mile from native huts, and in many instances by a few hundred yards only. Half a mile would, we believe, afford absolute protection.

6. Segregation in towns also is practicable. It exists at Accra (Gold Coast), and is moreover the condition met with throughout India, viz., European cantonment and native bazaar.

7. The diminution of native malaria, as a whole, is an extremely difficult and costly task. The most efficient means to accomplish this end is drainage.

Blackwater Fever—Nature—Prophylaxis.

8. Cases of malaria may occur where parasites are absent in the peripheral circulation. In such cases there are two subsidiary means of diagnosis:—(1) The presence of pigmented leucocytes. (2) An increase in the percentage of the large mono-nuclear leucocytes.

9. In blackwater fever parasites are generally absent; but by the use of these subsidiary tests proof of its malarial origin may still be obtained.

10. Blackwater fever is not due to a special parasite; but, in spite of the frequent absence of parasites, is malarial in origin. And, moreover, it is not infrequently in direct association with a preceding infection. For

11. In the only case of blackwater fever seen by us *before* the onset of the hæmoglobinuria, parasites were present in abundance. After the hæmoglobinuria they rapidly disappeared. So far as we know, no exception to this fact has been observed.

12. Further, blackwater fever is most commonly induced by quinine, not necessarily in a large dose.

13. Quinine is dangerous solely when it is inefficiently administered, *i.e.*, in those who, in spite of taking quinine, suffer from constant malarial attacks.

14. Blackwater fever is as common in the Bengal Duars as in any region of Africa visited by us. It is also present in the Madras Presidency (Jeypore) and in Assam.

15. Blackwater fever only exists in regions of *intense* malarial endemicity.

16. The prophylaxis of blackwater fever is identical with that of malaria, viz., efficient segregation from the ever-present source of native infection.

Malarial Endemicity.

17. The endemic index or endemicity of a village or district may be defined as the percentage of children (under ten) carrying parasites in their blood.

18. In *any particular district* the endemicity varies directly with the proximity of breeding grounds of anopheles.

19. In villages with no breeding grounds nearer than half a mile, in the dry season the endemic index may be as low as 5 per cent., and not infrequently 0 per cent.

20. On the other hand, the presence of *anopheles* in abundance is in itself not sufficient to cause a high endemic index.

21. Myriads of anopheles may occur in villages, and yet the endemic index be 0, even if the species of *anopheles* present is one that carries malaria elsewhere. Three such villages were found by us in India. (Paludismus sine malaria.)

22. There are unknown factors—regional factors—which determine why one district has a high endemic index and another a low one.

The Part played by Species of Anopheles in determining Intensity of Malaria.

23. Endemic malaria is in probability *in part* determined by the species of *anopheles* present, for whereas in Calcutta, where *A. Rossii* abounds, the endemic index is 0, in the Bengal Duars, where *A. Christophersi* is the principal *anopheles*, the endemic index is 72.

24. That species is a factor, is, we consider, shown by the result of our dissections of two species of *anopheles* caught in the same huts at the same time. Thus:

1. Mian Mir.

	Anopheles dissected.	Number with sporozoits.	Percentage sporozoits.
A. culicifacies	259	12	4·6
A. Rossii.....	496	0	0

2. Ennur.

A. culicifacies	69	6	8·6
A. Rossii.....	364	0	0

25. Although we believe on these grounds and others of a more general character that *A. Rossii* does not carry malaria in nature, yet experimentally it does, as do all other species used by us.

26. Other anopheles, viz., the "wild" or "non-foveal" species, *e.g.*, *A. Barbirostris*, probably also do not carry malaria in nature.

27. The distribution of the particular varieties of malaria parasite in India is peculiar; thus, in the Duars and Jeypore (Madras) the infection among the natives was almost exclusively quartan, while in the Punjab quartan was rare.

28. *A. culicifacies* was the only *anopheles* in which we succeeded in developing quartan sporozoits, but the number of experiments was not large enough to say that the other *anopheles* used did not carry quartan.

Habits of Anopheles—Classification—Malarial Cachexia, &c.

29. Marked peculiarities are shown by different species of *anopheles* in selecting breeding places. Thus, the larvæ of *A. Rossii* are found in shallow dirty puddles, those of *A. Barbirostris* never are, but only in weedy lakes. *A. Christophersi*, again, breeds in streams, but never in shallow pools. *A. Stephensi* not infrequently breeds in tins, and each group of *anopheles* has characteristic but different breeding grounds.

30. The flight of *anopheles may* extend to a quarter of a mile from breeding grounds, but rarely to half a mile.

31. Indian anopheles admit of a natural classification based upon the larval characters and those of the egg. In the different groups there are well-marked differences.

32. The egg of *A. Turkhudi* is remarkably aberrant in type.

33. In the larva the antennal hair, clypeal hairs, and palmate hairs are of specific importance.

34. Fertilisation of the female is not essential for the *anopheles* to develop parasites (zygotes).

35. In the glands of certain species of Culex, bodies resembling sporozoits were found by us. Their nature remains unelucidated.

36. Sporozoits were shown by us to be capable of agglutination like bacteria. We are unable to say whether any specific relation exists to the serum of a malaria patient.

37. The so-called "malarial cachexia and enlarged spleen" of India (Calcutta) has no immediate connection with an active parasite infection.

Note.—The following is a complete list of reports sent in by us :—

1. The Malarial and Blackwater Fevers of British Central Africa. (December 10, 1899.)
2. Distribution of Anopheles in Sierra Leone (including a Report on Blackwater Fever). (April 5, 1900.)
3. The Native as the Prime Agent in the Malarial Infection of Europeans. (May 17, 1900.)
4. Note on Certain Bodies found in the Glands of two Species of Culex. (May 17, 1900.)
5. The Malaria of Expeditionary Forces and the Means of its Prevention. (May 17, 1900.)
6. The Agglutination of Sporozoits (Preliminary Note). (July 14, 1900.)
7. The Malarial Infection of Native Children. (October 1, 1900.)
8. On the Destruction of Anopheles in Lagos. (October 1, 1900.)
9. Note on Malarial Fever contracted on Railways. (October 1, 1900.)
10. The Segregation of Europeans. (October 1, 1900.)
11. The Anatomy and Histology of the Adult Female Mosquito. (August 13, 1900.)
12. The proposed site for European Residences in the Freetown Hills. (November 26, 1900.)

13. The increase in the number of large Mononuclear Leucocytes as a Diagnostic Sign of Malaria. (November 26, 1900.)
14. Malarial Fever without Parasites in the Peripheral Blood. (November 26, 1900.)
15. The Tonicity of the Blood in Malaria and Blackwater Fever. (November 26, 1900.)
16. Blackwater Fever. Cases IX to XVI. Summary and Conclusions. (November 26, 1900.)
17. The Relation of Malarial Endemicity to Species of *Anopheles*. (October, 1901.)
18. Some Points in the Biology of the Species of *Anopheles* found in Bengal. (October, 1901.)
19. The Relation between Enlarged Spleen and Parasite Infection. (October, 1901.)
20. The Classification of Indian *Anopheles* into Natural Groups. (February 6, 1902.)
21. The Relation of Species of *Anopheles* to Malarial Endemicity. (February 6, 1902.)
22. The Relation of Species of *Anopheles* to Malarial Endemicity (Further Report). (April 15, 1902.)
23. An Investigation into the Factors which determine Malarial Endemicity. (April 25, 1902.)
24. Note on Bodies in Salivary Glands of *Anopheles*, &c. (April 25, 1902.)
25. Occurrence of Blackwater Fever in India. (October, 1901.)
26. Malaria in an Indian Cantonment (Mian Mir) : an Experimental Application of Anti-malarial Measures. Preliminary Report.

REPORT BY CAPT. S. P. JAMES, I.M.S.

"A Report of the Anti-malarial Operations at Mian Mir (1901—1902)." By Captain S. P. JAMES, M.B. (Lond.), I.M.S.

Part I.—GENERAL.

The operations to be described in this report were initiated with the object of demonstrating in an experimental way that malarial fevers can be prevented by practical measures based on the discovery of the mosquito cycle of the malarial parasite.

Choice of a Station.

Our original object was chiefly to test the efficacy of mosquito destruction in the prevention of malaria, and it was necessary, therefore, to select a station in which it seemed probable that a marked reduction in the number of mosquitoes could be effected. It was also desirable to choose a very malarious station, in order that the results of our experiments might be more evident. From both these points of view the cantonment of Mian Mir appeared to be suitable, for as regards the possibility of reducing *anopheles*, it was evident that, the rainfall being a small one during the greater part of the year, breeding places could only exist in connection with irrigation works; and as regards the prevalence of malaria, this cantonment is recognised as being one of the most unhealthy in the Punjab.

Situation and General Account of Mian Mir.

Mian Mir cantonment is situated on a level plain 6 miles to the south-east of Lahore city, and about 4 miles to the east of the civil station. The locality was selected in 1851–52, when it was decided to abandon the former cantonments at Anarkali (in Lahore) on account of their unhealthiness. The new cantonment was at that time a treeless desert, but many trees have since been planted, and in all parts to which irrigation extends good gardens and grass lands have been laid out. The ordinary garrison of the cantonment is made up as follows:—

2 batteries of Royal Field Artillery.
1 regiment of British Infantry.
1 regiment of Punjab Pioneers.
1 regiment of Native Infantry.
1 regiment of Bengal Cavalry.

The total number of officers and men of these regiments averages about 3900, and in connection with the ambulance and transport establishments there are in addition about 600 native followers.

The arrangement of the cantonment is as follows:—On the extreme north is the bazaar of the British infantry, and to the south-west of it is their hospital. Then follow to the south the lines of the European infantry, with the officers' quarters on the east, and the Catholic chapel and rifle range beyond; then to the east by south of these again is the quarter guard, the magazine, and another set of officers' quarters to the east. Then follow, to the south, the racket court and executive engineer's office, and to the east of these the lines of the native infantry, and again to the south of these the Royal Artillery lines, and at the extreme south the lines of the native cavalry.

Rainfall and Climate.

The average annual rainfall in Mian Mir is about 20 inches. The following table, giving the average rainfall for each month of the years 1868–1892, shows the distribution of the rainfall throughout the year:—

Month.	Average rainfall in inches.
January	0·6
February	1·1
March	0·6
April	0·4
May	0·8
June	1·5
July	5·7
August	4·6
September	2·0
October	0·3
November	0·1
December	0·5

The greatest amount of rain falls, therefore, from June to September, the chief fall being in July.

The hottest month of the year is June, the temperature in a carefully shut house in that month varying from 96–106° F., and unless rain comes, the heat lasts on into July.

The hot weather indicates its approach in April, but indoors it is fairly comfortable until May. Then the air becomes very dry, and hot burning winds commence. The nights are warm, but not troublesome during May, and both April and May are comparatively healthy months for Europeans. In June the heat increases considerably, and hot winds are prevalent. Early in July there is generally a burst of the monsoon rain, but owing to its short duration its cooling effect only lasts for a few days, and unless more rain comes, the great heat begins again, and is rendered worse by the increased moisture of the air. Throughout July and August the nights are very hot, and in the

latter month searching hot breezes sometimes spring up, which are especially trying in Mian Mir. In September the nights begin to be less hot, and from September 15 the days, also, are distinctly cooler. Early in October it is quite cool out of doors, and by the middle of the month the weather becomes very pleasant. This, however, is the month when malarial fevers are most prevalent. November and December days are bright and clear, and the nights cold. Rain sometimes falls before the end of December. In January and February early morning frosts are noticeable. March is very variable, but generally pleasant, and in April the hot weather begins to make itself felt again.

Barracks of the Troops.

The European troops are housed in lofty one-storied stone buildings provided with a wide verandah, and raised some feet off the ground. In the hot weather punkahs are provided by day and night.

Water Supply.

The European troops have a pipe water supply for drinking purposes. The water supply of the native troops is from wells, of which there are a very large number in the cantonment.

Surface Drainage.

One of the worst features of Mian Mir as a cantonment is the fact that the plain on which it is situated is so level that very little of the surface water can drain away. The whole cantonment is interlaced with brickwork surface drains, but in none of these is there any sufficient fall, and the majority end abruptly on the level plain in the middle of the cantonment. In the construction of these storm-water drains there appears to have been no definite object, and they are indeed of more harm than good, for whenever a slight shower of rain falls they become full of water, which remains in them until dried up by the sun. For this reason, they form during the rainy season prolific breeding places of *anopheles* mosquitoes.

Character of the Soil.

The surface layer consists for the most part of very dry, finely-powdered mud and sand, which, during the fierce winds of the hot weather, is blown about in clouds of dust. Beneath this superficial layer the soil consists for the most part of clay and *kanker* (a soil used for making roads, and which on treatment with water becomes hard and impervious).

In consequence of the soil being for the most part impervious to

water, after one or two hours' rain the appearance of the cantonment is changed from that of a dry arid plain to that of a district in flood. Broad expanses of water often a quarter of a mile in extent cover the plain on every hand, and the inhabitants of the followers' huts on some of the comparatively low-lying parts are literally flooded out. The majority of these large expanses of water dry up in the hot sun in three or four days, but numerous small pools are left which, lasting for a week or ten days, form excellent breeding places of *anopheles*.

Irrigation Works.

In the absence of irrigation Mian Mir would, during the greater part of the year, be little better than an arid desert. A branch of the main irrigation canal enters the cantonment, and from this numerous shallow channels (irrigation watercourses or "cuts") convey water to all the gardens, grass land, and crops in the cantonment. The water is drawn up from these channels by means of Persian wheels ("*Jhalars*") and distributed over the land in shallow ditches. No crops requiring continuous irrigation are grown in the cantonment, and the plan usually adopted is to water a certain area of land one day and another the next, so that the water has time to soak into the ground or dry up before the next supply is given. In the garden portions the plan is usually for the Persian wheels to work about three hours daily, and all the water given has generally soaked into the ground by the same evening.

At certain times of the year the supply of water is frequently shut off for ten days or more at a time. This is shown in the following table:—

Table showing the Number of Days of each Month during which Irrigation Water was supplied to Mian Mir Cantonment for some years between 1892 and 1901.

	1892.	1893.	1897.	1898.	1899.	1900.	1901.
January ...	16	3	11	7	10	0	3
February...	13	0	4	7	19	9	0
March.....	23	4	22	21	26	22	27
April.....	24	22	28	30	25	27	27
May	26	21	31	31	31	31	30
June	28	25	29	30	30	21	23
July.....	18	28	31	29	31	28	28
August	14	31	31	31	31	14	21
September..	22	22	30	30	21	19	30
October....	30	30	23	21	14	28	20
November..	30	0	20	20	10	21	16
December..	31	0	18	20	14	15	7

Before any anti-malarial operations in a place can be carried out with any hope of success, it is necessary to have exact knowledge of the real prevalence of malaria in the place and of the conditions on which this prevalence depends. Our previous work had shown that the general opinion of the inhabitants of a place as to its healthiness or otherwise, and even the statistics of admissions into hospitals for "fevers," are of little value as an indication of the prevalence of malaria and the danger of infection.

Before commencing operations in Mian Mir therefore we spent some time in a study of the prevalence of malaria there and the conditions which determine it.

The Prevalence of Malaria in Mian Mir and the Conditions determining it.

As will be seen from the following table, Mian Mir is one of the most unhealthy cantonments in this part of India :—

Table showing the Average Annual Admission Rate per 1000 of Average Strength for "Ague" among European Troops for the Years 1896—1900 inclusive in some Stations of the Punjab and United Provinces.

Mian Mir	663·0	Agra	259·0
Sialkot	271·0	Delhi	1145·6
Rawalpindi.....	289·0	Meerut	477·2
Amritzar	445·6	Fatehgarh	464·4
Jullundur	260·9	Cawnpore	294·5
Ferozepore.....	760·6	Lucknow	204·3
Umballa...	289·8	Fyzabad.....	231·2
Jhansi.....	355·7	Fort Allahabad...	400·6
		Benares	273·2

The number of admissions per 1000 for malarial fevers among European troops at Mian Mir, during the year 1901, is shown in the following table :—

European Troops at Mian Mir. Malarial Fevers ("Ague" and "Remittent"). Admitted per 1000.

1901.		1901.	
January	152·0	July	63·5
February	68·3	August	126·9
March	69·5	September	153·1
April	63·4	October	219·8
May	159·4	November	143·3
June	141·4	December	62·8

From this table it would appear that malarial fevers are prevalent in Mian Mir throughout the year. This is not, however, the case, and a large number of the cases recorded in the hospital returns are doubtless due to relapses.

It is certain also that other diseases than malaria are often returned under the term "ague." In order to ascertain what proportion of the admissions for "ague" were really due to malaria, a number of men admitted for this disease were examined in October, 1901, by Dr. Christophers, and in 40 per cent. of these, malarial parasites were found. In the same way I examined a number of men admitted or "detained" for ague during September, 1902, before any quinine had been administered to them, and found malarial parasites in 45 per cent. of the cases examined. During this month also, through the courtesy of Major Gordon Hall, R.A.M.C., no quinine was administered as medicine to a number of cases in which I had not found parasites. All of them recovered in from one to three days without any quinine treatment, and from this fact and the fact that several examinations of each case failed to show the presence of parasites, I conclude that these cases of fever were not due to malaria, though usually entered as such in the returns. The charts of some of these cases are given in an appendix to this report (see Appendix A).

In considering hospital statistics, however, if we regard the ratio of error to be about the same each year, we may derive useful *comparative* information regarding the prevalence of fevers in different years and at different seasons. For this reason the following tables are given here (p. 33).

It will be seen from these tables that the largest number of admissions for malarial fevers occurs, as a rule, between August and November.

A more reliable method of estimating the prevalence of malarial fevers and the liability to infection is given by an examination of young children, in order to find the percentage infected with malarial parasites. Drs. Stephens and Christophers have added to this method the estimation of the percentage of *anopheles* mosquitoes infected with sporozoites in the salivary glands, as indicating more accurately the actual danger of infection. Every cantonment in India has a number of followers' lines and native bazaars attached to it, and the examination of the children in these lines and bazaars affords a ready means of estimating accurately the prevalence of malaria and the liability to infection.

European Troops at Mian Mir. Malarial Fevers (Ague and Remittent). Admitted per 1000.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1892.....	56·8	41·4	46·7	40·3	55·6	62·2	57·3	149·3	110·9	165·9	196·7	123·5
1893.....	54·2	35·0	55·4	41·2	74·6	109·7	156·9	142·6	81·0	134·3	102·4	88·3
1894.....	49·1	14·1	7·4	3·9	56·1	58·1	85·3	146·0	203·9	332·5	223·5	193·0
1895.....	118·2	84·1	106·3	189·1	152·9	174·9	143·9	127·6	125·0	148·0	166·4	32·7
1896.....	12·1	3·9	6·7	14·1	10·8	43·5	33·7	9·6	47·2	87·5	37·0	28·9
1897.....	10·6	17·2	23·5	12·5	14·9	15·2	23·5	19·8	106·0	58·4	284·8	186·9
1898.....	84·5	33·6	30·4	45·0	68·9	5·2	24·0	10·8	88·8	209·1	126·0	97·8
1899.....	33·0	37·6	38·6	36·8	80·7	56·7	50·8	29·8	58·2	49·9	18·0	6·6
1900.....	15·4	9·0	21·7	24·5	11·1	16·2	9·3	29·7	138·8	356·4	261·3	229·1
1901.....	152·0	68·3	69·5	63·4	159·4	141·4	63·5	126·9	153·1	219·8	134·3	62·8

Native Troops at Mian Mir. Malarial Fevers. Admitted per 1000.

Years.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1892.....	25·7	12·6	17·1	26·0	33·0	14·2	3·6	33·3	52·2	88·0	54·0	16·1
1893.....	6·8	4·9	4·2	6·2	8·2	7·3	15·2	46·5	15·2	27·9	19·9	34·3
1894.....	28·3	21·4	6·3	16·8	14·2	8·7	25·4	47·8	91·7	136·6	40·2	30·9
1895.....	4·6	1·3	4·0	13·6	23·0	7·7	28·7	37·5	120·9	146·3	21·2	19·5
1896.....	8·5	5·2	7·6	4·2	4·3	8·2	18·2	12·9	13·7	13·1	13·8	4·4
1897.....	3·5	1·0	2·7	5·8	10·6	10·4	11·1	20·3	73·5	119·0	141·2	48·3
1898.....	16·2	9·0	11·1	13·9	27·0	35·9	22·6	113·6	100·5	219·0	160·3	42·7
1899.....	20·8	10·5	16·4	13·6	20·0	6·8	19·9	12·3	8·4	17·8	19·9	9·2
1900.....	8·1	2·3	6·9	18·1	28·0	23·2	12·4	23·0	55·9	178·8	88·9	114·5
1901.....	49·8	21·2	14·6	47·7	67·9	42·3	32·2	26·5	43·4	114·4	43·9	22·7

The following table shows the results of the examination of children in the different bazaars of Mian Mir made in October, 1901 :—

Table showing the Prevalence of Malaria in Mian Mir.

Locality.	Time of year.	Percentage of children infected with malaria parasites. ("Endemic index.")	Percentage with enlarged spleens.
British Infantry Bazaar	October, 1901	52·0	80
Royal Artillery Bazaar	„ „	35·0	75
Native cavalry lines ...	„ „	25·0	36
Syce lines (A)	November „	56·5	48
Syce lines (B)	„ „	20·0	20

The "endemic index" of some of these bazaars is a high one, and it is evident that in the months in which the examinations were made malarial fevers are very prevalent in Mian Mir and the liability to infection great.

In order to ascertain correctly the seasonal variations in the prevalence of malaria at Mian Mir, I have examined a number of the children in the bazaars as frequently as possible throughout the year, and these results, together with those obtained last year, may be tabulated as follows :—

To show the Seasonal Prevalence of Malaria in Mian Mir.

Locality.	Date.	Endemic index.	Spleen rate.	Number examined.
		Per cent.	Per cent.	
British Infantry Bazaar..	October 5, 1901	52·0	80	25
	November 25, „	20·0	38	25
	June 17, 1902	8·3	26	24
	July 28, „	8·5	37	35
	August 25, „	15·0	60	20
	September 17, „	32·2	65	31
	October 22, „	42·3	69	29
	November 19, „	27·0	57	24

From the above table we may say that the season of new infections in Mian Mir begins at the end of July or the beginning of August, and that the number of new infections increases steadily until it reaches a maximum in October. As soon as the endemic index begins to decrease, it may be assumed that new infections have ceased, and the sudden fall in the percentage of infected children in November affords

a proof of this. From November until July of the next year any cases of malaria that occur are relapses of former infections.

The Factors Determining the Prevalence of Malaria in Mian Mir.

In considering the factors on which the prevalence of malarial fevers in Mian Mir depends, the influence of the presence of *anopheles* mosquitoes must be taken first. After determining the endemic indices of the bazaars in October, 1901, our next object was to find infection in *anopheles* mosquitoes.

Only two species of *anopheles* were at all abundant, viz., *A. Rossii* (Giles) and *A. culicifacies* (Giles). Other species, which will be referred to later, were present but not in large numbers. *A. Rossii* was more abundant than *A. culicifacies*, but both species were found in all the bazaars, in the barracks of the troops, and in the hospital and jail.

In view of the fact that our other work in India had led us to the conclusion that *A. Rossii* was a very inefficient carrier of malaria under natural conditions, while *A. culicifacies* was a very good one, we selected a bazaar for the examination of *anopheles* where the two species could be caught in fair numbers in the same houses in order to compare their rates of infection.

The results of our dissections were as follows:—

Species of *anopheles*.	Number dissected.	Number with sporozoites in the glands.	Percentage infected with sporozoites.
A. Rossii	496	0	0·0
A. culicifacies	259	12	4·6

It is evident from these results that *A. culicifacies* is the chief if not the only carrier of malaria in Mian Mir, and the knowledge that *A. Rossii* is of little if any importance in conveying infection under natural conditions is of great importance in connection with anti-malarial operations.

Six species of *anopheles* have been found by us in Mian Mir, viz.:

A. Rossii. *A. pulcherrimus.*
A. culicifacies. *A. fuliginosus.*
A. Stephensi. *A. nigerrimus.*

The seasonal prevalence of these species in 1901—1902 was as follows:—All the species were found during October and the first week of November, 1901. *A. Rossii* was exceeding abundant and almost any number could be caught with ease in all the bazaars and barracks.

A. culicifacies was also present in fair numbers, though not so plentiful as *A. Rossii*. All the other species were comparatively rare, and it would have taken many weeks to catch a sufficient number of any of these species to render their dissection of advantage. During the second week of November the number of adult *anopheles* began to decrease rapidly, and November 28 was the last date on which any adult *A. culicifacies* were caught in the houses. Two adult *A. Rossii* were caught in one of the bazaars on December 5 after an hour's search, but these were the last adults seen during the winter of 1901, though search was frequently made during December. The larvæ also diminished very rapidly, but a few were still present in some old pools on December 20, and in pools which remained without drying up in Lahore throughout the winter, a certain number of larvæ could always be found, though no adult insects appeared to be present in the houses. In newly formed pools, however, no larvæ appeared, and it is probable that larvæ found during the winter are old ones which remain alive, but which are unable to develop into pupæ and adults until the spring.

A few new larvæ can be found in March, but adult *anopheles* are so few that it is difficult or impossible to detect them in the houses. Indeed, it is not until the middle of May that adult *anopheles* become sufficiently numerous in the houses to be detected by searching, and until this time larvæ also are scanty, though gradually increasing in numbers.

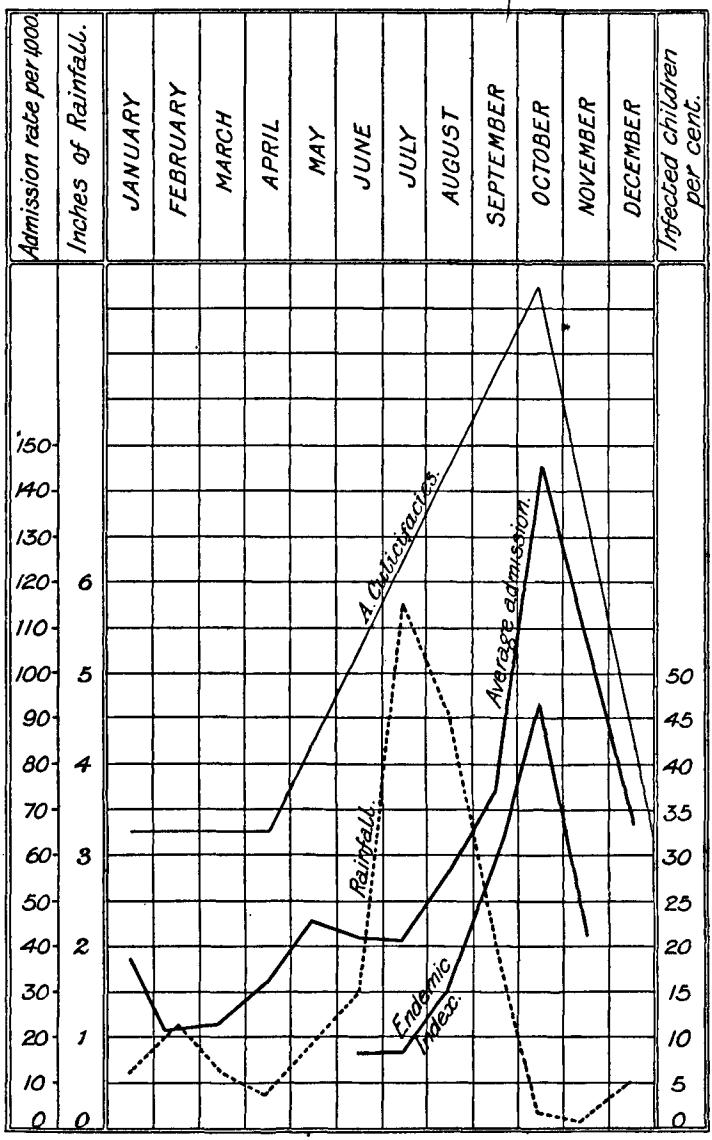
From the middle of May onwards the number of larvæ and the number of adult insects increases steadily to a maximum in September and the beginning of October.

In November the numbers begin again to diminish rapidly.

The seasonal prevalence of the two species *A. culicifacies* and *A. Rossii* does not exactly correspond. *A. culicifacies* appears much earlier than *A. Rossii*. Although moderate numbers of *A. culicifacies* could be caught in the bazaars during May and June, not a single adult *A. Rossii* was found until the beginning of July. As soon, however, as *A. Rossii* appears it increases very rapidly and in a short time becomes far more abundant than any other species. This may be accounted for by the fact that whereas *A. culicifacies* breeds chiefly in the irrigation water-courses which are running more or less throughout the year, *A. Rossii* is dependent for its breeding grounds chiefly on rain-formed pools, so that it does not appear in any abundance until the heavy rains of July commence (see Chart II).

By means of the following chart the seasonal prevalence of *anopheles* of malarial fevers, and the rainfall may now be compared.

CHART I.



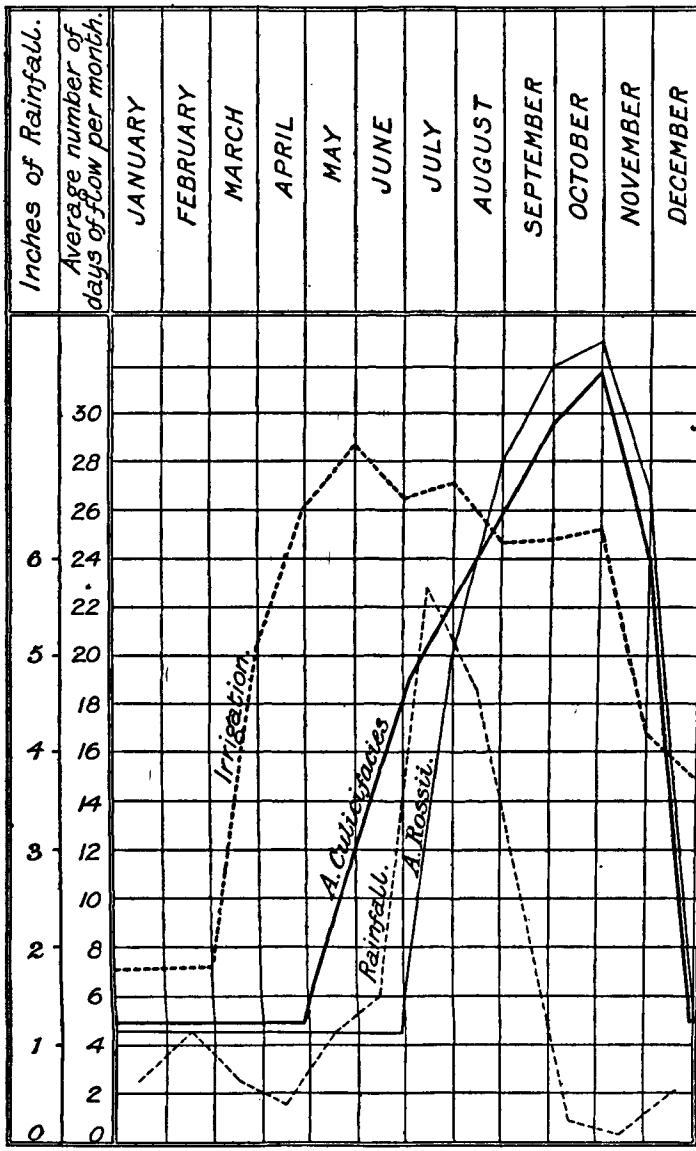
——— *A. Culicifacies curve (1901-1903).*

---------- *Rainfall (average 1868-1892).*

——— (Upper) *Average admission rate per 1000 (British and Native troops 1892-1901).*

——— (Lower) *Endemic Index of British Infantry bazaar 1901-1902. (Right hand figures).*

CHART II.



---------- Curve of irrigation supply to Mian Mir (average of 7 years).

———— Curve of A. Culicifacies.

---------- Rainfall (average 1868-1892).

———— Curve of A. Rossii.

It will be seen from this chart that the seasonal prevalence of malarial fevers in Mian Mir corresponds very accurately with the prevalence of *anopheles*. In 1902 the first *anopheles* (*A. culicifacies*) were found in the houses on May 20. The first slight rise in the endemic index, *i.e.*, the commencement of the seasons of new infections, was noted a month later, which (allowing ten days for the parasites to develop to the sporozoite stage in the mosquito, and twenty days for the incubation period in man) is the earliest time at which new infections could occur. During August, September and October the abundance of *anopheles* and the endemic index of the bazaar increased together, and in November, with the almost sudden disappearance of adult *anopheles*, the endemic index quickly falls.

The connection between the flow of the irrigation water supply and the prevalence of *Anopheles culicifacies*, and between the rainfall and the prevalence of *Anopheles Rossii*, is shown in Chart II.

In addition to the influence of the presence of suitable breeding places formed by irrigation or by rain, the factor of temperature is, of course, a very important one in connection with the seasonal prevalence of *anopheles*, and the disappearance of all species of this genus in December is to be ascribed rather to the onset of the cold weather than to an absence of suitable breeding grounds.

As further illustrating the close connection which exists between the prevalence of malarial fevers in Mian Mir and the presence and relative abundance of *anopheles*, the conditions found in different bazaars and followers' lines may be given in more detail.

The inhabitants of these bazaars live in exactly the same class of house, derive their drinking water from the same source, and are exposed to the same climate and temperature. They are, in fact, under precisely similar conditions, except that the bazaars or lines are at different distances from breeding places of *anopheles*. As would be expected, the number of adult *anopheles* that can be caught in the different bazaars and lines varies with the distance from the breeding place. It will be seen from the following table that the prevalence of malaria is least in the lines that are furthest from a breeding place, and where consequently fewer *anopheles* can be found, and greatest in the lines that are nearest a breeding place, and where a larger number of *anopheles* are present :—

Table showing the Influence of Breeding Places of *Anopheles* on the Prevalence of Malaria in Mian Mir.

Name of locality.	Distance of nearest breeding place and its character.	Species of *anopheles* found, and abundance.	Endemic index per cent.	Spleen rate per cent.
British Infantry bazaar.....	Irrigation watercourse, 30 yards Pools, 40 yards	*A. culicifacies*, *A. Rossii* } abundant *A. fuliginosus*, *A. pulcherrimus*, *A. nigerrimus* } rare	52	80
Royal Artillery bazaar.....	Irrigation watercourse, 172 yards Pools in bazaar	*A. culicifacies* not very abundant *A. Rossii* abundant *A. Stephensi*, *A. pulcherrimus* } scanty	35	75
Syce lines A.....	Irrigation watercourse, 125 yards	*A. culicifacies*, *A. Rossii* } abundant	56	48
Syce lines B.....	The same watercourse as Syce lines A, 584 yards	*A. culicifacies*, *A. Rossii* } scanty	20	20

An experiment which I carried out during the year, and which will be again referred to in the account of the operations, also illustrates in a remarkable way how entirely the prevalence of malaria is influenced by the presence or absence of *anopheles*. This experiment was the removal of the inhabitants of the Syce lines A, referred to in the above table, into tents on a new site ¾ of a mile from the nearest irrigation watercourse and 600 yards from any pool. No *anopheles* were ever found in these tents, and the result of the experiment was the reduction of the percentage of infected children from 56 per cent. at the height of the fever season in 1901, to 4 per cent. at the same time in 1902.

Species of Parasite in Mian Mir.

Only two forms of the malaria parasite have been met with in Mian Mir, viz., the benign tertian and the malignant tertian forms. Out of 66 infections occurring in native children, 40 were with the benign tertian parasite and 26 with the malignant tertian.

Among the European troops the proportion of simple to malignant tertian infections is greater than this. Out of 18 infections among the men of the Royal Artillery in November, 1901, fourteen were with the simple tertian parasite and four with the malignant tertian.

No quartan parasites have been found in Mian Mir.

The Royal Artillery Lines.

On account of the wide area over which Mian Mir extends, it was decided to limit the anti-malarial operations chiefly to the lines of the Royal Artillery, which are more or less isolated from the rest of the cantonment. The foregoing general account refers to Mian Mir as a whole, and it is now necessary to add a few details regarding the portion of the cantonment in which the operations have been chiefly carried on.

1.—*The Sources of Infection of Anopheles in the Royal Artillery Lines.*

It has already been shown that a high percentage of the young children in the various bazaars and followers' lines are infected with malaria parasites, and as these children receive no treatment whatever, it may be assumed with some certainty that they form the chief source from which *anopheles* mosquitoes become infected.*

* *Vide* also 'Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India,' New Series, No. 2, 'Malaria in India,' by Capt. S. P. James, I.M.S., p. 61.

In the Royal Artillery lines there are five principal sources of this nature, viz. :—

(1) The Syce lines of the right battery. The infection of children in these lines is between 50 to 60 per cent., and the distance of the lines from the barracks is 175 yards.

(2) The hospital followers' lines. The infection of children in these lines is about 50 per cent., and they are situated within 30 or 40 yards of the hospital and prison.

(3) The Syce lines of the left battery. The infection of children is 20 per cent., and they are situated 400 yards from the barracks.

(4) The Royal Artillery bazaar. The infection of children is 35 per cent., and it is situated 440 yards from the barracks.

(5) The servants' quarters in the officers' bungalows. A large percentage of the servants' children who live in the bungalow compounds are infected with parasites, and they form a dangerous source of malarial infection to the Europeans living in the bungalows.

2.—*The Carrier of Infection in the Royal Artillery Lines.*

All the species of *anopheles* previously mentioned, except *A. nigerrimus*, are found in the Royal Artillery lines. As in other parts of the cantonment, *A. Rossii* is by far the most abundant, and enormous numbers of this species can be caught from July to November in the houses of the bazaar and lines, in the barracks, hospital and prison. *A. culicifacies* is also abundant throughout the lines, and adults of this species can be easily caught in the bazaars and barracks. This is undoubtedly the species by which infection is chiefly, if not entirely, carried in Mian Mir. Other species of *anopheles* are very rare in the Royal Artillery lines.

The Breeding Places of Anopheles in the Royal Artillery Lines.

In most places the breeding grounds of *anopheles* during the rainy season and those during the dry season can be sharply marked off from each other, but owing to the flatness of the ground in Mian Mir and to its impervious nature, a slight shower of rain produces almost the same conditions as regards the presence of breeding places as in other districts are only produced during the true rainy season. At almost any time of the year, therefore, numerous rain-formed breeding places may exist in Mian Mir, and it will be better for this reason to enumerate all the places where *anopheles* larvæ have been found at any time during the years 1901 and 1902, indicating at the same time the relative importance of each breeding place.

(1) The larger irrigation channels ("*Rajbahas*").

(2) The irrigation watercourses.

(3) Water spread over the gardens and fields for irrigation purposes.

(4) Pools formed by overflow of the irrigation watercourses.

(5) Pools left in the bed of an irrigation watercourse when the supply of water has been cut off.

(6) A few large ponds or "tanks" and a large number of small stone reservoirs for collecting water in the gardens.

(7) Rain-filled pools, surface drains, rain-formed pools on flat areas of ground, etc.

(8) Domestic utensils. Tins and buckets of water kept in the lines in case of fire and for other purposes.

(9) The swimming baths.

(10) The small surface drains which carry off water from the standpipes, wells, cook-houses, baths, etc.

(11) The wells.

(1) *The Larger Irrigation Channels.*—The velocity of the water in the main "*Rajbaha*" bringing water into the Royal Artillery lines is considerable, and except at the bridges which cross the channel at many places, and which check the flow of water, larvæ are rarely to be found.

(2) In the smaller distributing channels, however (irrigation watercourses or "cuts"), which form a network throughout the cantonment, the flow of water is slow, and is frequently further impeded by a thick growth of grass and vegetation along the sides of the watercourse.

Many of these ditches also have no outflow, and end only in the basin of a Persian wheel, so that the water in them is quite stagnant except during the time that the Persian wheel is working (about 3 hours daily).

All these irrigation watercourses form ideal breeding places, and are the main source of *anopheles*—especially of *A. culicifacies*—in the cantonment. Many larvæ can, as a rule, be found in them throughout their length, but they are especially numerous in places where grass and weed are growing at the edge, and also at the bridges where the flow of water is checked.

(3) The water distributed over the land dries up quickly as a rule, but even in this dangerous breeding places of *anopheles* are sometimes found. The young trees in Mian Mir are planted along the bed of small distributing ditches, and round each tree it is usual to dig the ditch deeper so that a pool of water may be formed. These pools are frequently so deep that all the water given in one day does not dry up before the next supply comes on the following day, and I have frequently found *anopheles* larvæ and pupæ in these pools.

Similar pools are formed in many parts of the gardens of the

officers' bungalows, owing to the unevenness of the ground. The supply of irrigation water to the cantonment is a very intermittent one, and during the comparatively short periods in which irrigation water is available, it is everyone's object to flood their gardens as much as possible. Owing to the impervious nature of the soil and to the general levelness of the ground, if more water is given to a garden than can all be soaked up in a day, it collects and forms pools in any depressions of the ground. These pools being replenished daily, may last for ten days or more.

(4) When the irrigation water supply is cut off from the cantonment, many pools are left in the watercourses. The number of larvæ found in these pools varies considerably. In many of them no larvæ can be found, in others, however, larvæ are so numerous that the surface of the pool is almost covered with them. In the winter these pools are of great importance, for during December, January and February, when the irrigation water supply is cut off for long periods at a time, *anopheles* larvæ can remain in a resting condition in the pools under the bridges until the warm weather comes again. This is, in fact, the chief if not the only means by which *anopheles* mosquitoes can tide over the cold of winter in Mian Mir.

During the cold winter months no adult *anopheles* can be found in the houses, but in such pools as these larvæ are found in a more or less "hybernating" condition, that is, they do not grow at all, or grow extremely slowly, until the warm weather comes again.

(5) Numerous pools are formed by overflow of the irrigation watercourses, and large numbers of larvæ (*A. Rossii*) are found in these. Occasionally, from the breaking down of the sides of a watercourse, a very extensive overflow is made, forming a pond which may last for some months. In such an overflow the larvæ of *A. Fuliginosus* and *A. nigerrimus* were found.

(6) In the brick-lined "tanks" for bathing purposes, which are found near some of the bazaars, larvæ are rarely present, but there are also a few ponds, the sides of which are not brick-lined, and in these *anopheles* larvæ are not uncommon. In every garden there are a number of small brick tanks for collecting water for irrigating purposes. They frequently contained *anopheles* larvæ.

(7) Rain-formed pools are exceedingly numerous, and it is difficult to realise the difference which even a small shower of rain makes in the aspect of the cantonment. Large ponds of water cover the plain on every hand, and for 2 days after a few hours' rain parades on the Royal Artillery parade ground become impossible. To reach the Syce lines of the batteries one has to wade through water for several hundred yards. The whole cantonment is in a similar condition. Most of these large sheets of water dry up under the hot sun in 2 or 3 days, but pools of water remain in depressions of the ground and in all the surface drains

until the next shower of rain. The condition indeed, is one of the presence of innumerable pools constantly exposed to a hot sun, and constantly being replenished with fresh water—a condition eminently suitable for the breeding of *anopheles*. It is not surprising, therefore, that in all these pools and in all the surface drains numerous larvæ are found during July and August.

(8) Two large covered-in swimming baths for the troops are present in the Royal Artillery lines. Although these are constantly used by the men, numerous *anopheles* larvæ were found in both the baths during the summer. The baths take about 2 days to empty and nearly a fortnight to refill, and the water in them is not completely changed more than three or four times during the whole summer.

(9) The waste water from the wells, standpipes, cook-houses and baths, is carried off in small brick channels 2 or 3 inches deep. In all of these channels *anopheles* larvæ were found at different times of the year.

(10) Numerous tins and earthenware vessels of water are kept in the lines in case of fire and for other purposes. They frequently contained large numbers of *anopheles* larvæ.

(11) As a rule *anopheles* larvæ were not found in the wells, but in several which are only occasionally used larvæ were found.

The main irrigation *watercourses and other breeding places* are shown on the plan.

The above is a brief description of the conditions under which malarial fevers prevail in Mian Mir, and I may now refer to the operations which have been undertaken to combat it.

It should be noted that the primary object of the operations was to test the efficacy of mosquito destruction, and the chief efforts have, therefore, been directed to this end.

In an experiment such as this it is necessary to have some definite tests by which success or failure can be measured.

The following were the tests we proposed to employ:—

(1) Tests of a reduction in the number of *anopheles* mosquitoes.

(*a*) Larvæ. It can be made evident that though in previous years at the same time of the year larvæ were readily found, yet in the year of the experiment they were not so abundant.

(*b*) Adult *anopheles*. In any given bazaar or barracks it is possible for one who has regularly collected *anopheles* there, to say with certainty that they are more or less abundant. Also by making observations in a bazaar within the area of operations, and in one outside the area, it is possible to ascertain whether the operations are successful.

(2) Tests of a reduction in the amount of malaria.

(*a*) A reduction in the number of admissions for malarial fevers among the troops.

(*b*) A reduction in the percentage of infection with malaria parasites among the troops.

(*c*) A reduction in the amount of malaria in the regimental bazaars as measured by the percentage of children found infected with malaria parasites.

The first of these tests is probably the least to be depended upon, because hospital statistics may be affected by many causes; still unless it were possible to show a marked reduction in the number of admissions into hospital for "ague" the operations could not be considered successful. The most conclusive test of all would be the reduction of the percentage of infected children in the regimental bazaars. If as a result of the operations it could be shown that a marked reduction in the numbers of *anopheles*, and in the percentage of infected children in the regimental bazaars had occurred, the success of the operations would be proved.

Part II.—The Operations.

The operations were commenced on April 2, 1902. They will be described under the following headings:—

(1) Operations directed towards the destruction of mosquitoes.

(2) Operations directed towards the destruction of malaria parasites in infected individuals, or towards the removal of such individuals from the vicinity of the area of operations.

(3) Prophylaxis by quinine.

I.—*Operations against Mosquitoes.*

In order that all parts of the area chosen (viz., the Royal Artillery lines), might be systematically examined and dealt with week by week, I divided it, for the purposes of the work, under the following plan.

(1) The irrigation watercourses, viz., the main irrigation channel and its six chief branches, called respectively the first to the sixth branch, with their offshoots which supply the whole area of the Royal Artillery lines.

(2) The "Royal Artillery bazaar section," comprising the bazaar and the area surrounding it.

(3) The "barracks section," comprising the area round the main barracks, the hospital and prison.

(4) The "stables section" comprising the area round the stables, Syce lines, etc.

(5) The "gardens section" comprising the area of the officers' bungalows and gardens.

(6) The "pools section" comprising all the areas containing more or less permament pools.

One or more of these sections were carefully examined daily in regular order, so that no part of the lines could be left unexamined and unoperated upon for more than a week at a time. It was not possible of course to examine the whole of the watercourses in one day, but by taking one watercourse and the section near it (*e.g.*, the first branch and the bazaar section) the same day, and another branch and its adjacent section the next day, and so on, the whole of the area could be gone over during the week.

Methods Employed.

These were principally confined to operations against larvæ.

The methods used in the irrigation watercourses (running water) and in pools, and other collections of stagnant water, must be described separately.

(1) Methods employed in the irrigation watercourses.

(*a*) It has already been pointed out that the irrigation watercourses form the chief source of *anopheles* (especially of *A. culicifacies*) in the Royal Artillery lines, and that the larvæ are most numerous in these channels wherever any grass or weed is growing at the edges. Experiments which we had made in November 1901, pointed to the fact that if the sides of an irrigation watercourse are cut clean and smooth, so that the flow of water is not impeded, and if all grass and weed under which larvæ can shelter, is removed from the edges, the number of larvæ found in such a watercourse will be greatly diminished. The chief method employed was, therefore, based on this fact, and it was hoped that by constantly keeping the sides of the watercourses smooth and free from grass for many months, they might be made permanently unsuitable for the breeding of *anopheles* larvæ.

(*b*) A more effective and permanent means of carrying out the above principle was to have one of the watercourses lined with brick and smoothly plastered with cement. This was done with a length of watercourse running through the centre of the lines and in front of the main barracks and hospital (Plan of lines, p. 54. PP').

(*c*) For some weeks during June and July I tried the method of drying out and cleaning each branch once every 10 days. By this

plan all the larvæ present in the watercourses were killed before they had time to reach the pupa stage, but on account of the expense of drying out the channels, for most of the water had to be bailed out with buckets—and the fact that stopping the water at intervals interfered to some extent with irrigation—the plan was discontinued.

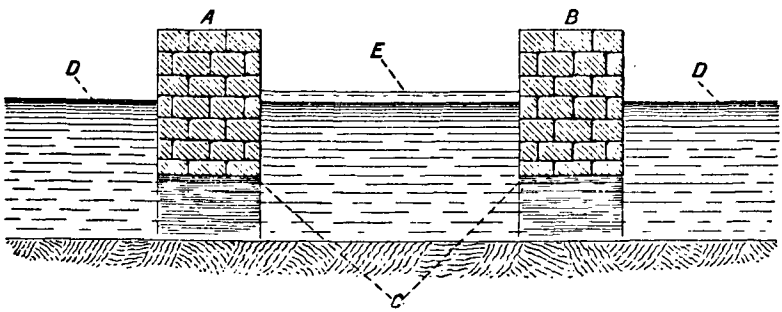
(*d*) The method of pouring oil on the watercourses. I have already mentioned that many of the watercourses contain almost stagnant water, and for these the plan of destroying the larvæ with kerosene oil naturally suggests itself.

Some experiments which I made on a plot of grass-land, kindly lent me for the purpose by the officer commanding the Royal Artillery, showed that even large quantities of kerosene oil poured round the roots of the grass had no injurious effect whatever, nor did it give any bad taste or smell to the grass, but, in spite of this, I consider that it would be inadvisable to use a method from which there would be a danger of any kerosene oil reaching the crops. Nor do I think it would be advisable to use a preparation such as "larvicide," which colours the water red. If in any year the crops were poor, it would certainly be put down by natives, and even by many Europeans, to the use of either of these substances.

With proper precautions, however, it is quite possible to pour kerosene oil on the watercourses in certain places without any of it reaching the land, and on this point my experiments showed the following results:—

(1) Kerosene oil poured on a watercourse between any two bridges does not pass beyond either. This is due to the fact that the bridges over the watercourses in Mian Mir are what are called "syphon bridges," that is, the depth of water in the watercourses is always greater than the height of the arch of a bridge, so that, as the oil floats only on the surface of the water, it cannot pass through the arch of the bridge. This is illustrated in the diagram below (fig. 1).

FIG. 1.



(2) For the same reason, if a deep board is placed over the mouth of a Persian wheel, half the board being under the surface of the water and half above it, oil can be safely poured on the watercourse without any of it being taken up in the buckets of the wheel.

(3) The water supply to the canals is frequently shut off for a week or more at a time. When this is done numerous pools are left in the watercourses, and, while these are drying in the sun, oil may be poured on them with great advantage.

The application of kerosene oil to the watercourses is therefore limited, and can only be carried out under careful supervision.

II.—*Methods employed for Pools and other Collections of Stagnant Water.*

(*a*) Pools formed in connection with irrigation. These comprise, firstly, more or less permanent large pools, formed from time to time by the overflow of a watercourse, or the breaking down of its banks. Such pools were, as far as possible, prevented from being formed by paying constant attention to the watercourses, building up their banks wherever there was danger of overflow, and digging them out, in order to keep the water level below the height of the bank. When any such pools had formed, they were temporarily covered with a layer of oil, and afterwards filled in with earth. Secondly, a number of small pools are formed in the gardens, by reason of the fact that all the water given to an area in one day does not always sink in or dry up before the next day's supply of water reaches it. Any small pool formed in this way is replenished each day, so that a pool lasting 10 or 12 days is made.

In the weekly examination of the garden section, pools of this nature containing *anopheles'* larvæ were frequently found. As the owners of the gardens might object to kerosene oil being used on land where plants and flowers were growing, the water of these pools were either drained away, or emptied out and thrown over the land.

Thirdly, numerous pools are left in the beds of the watercourses after the supply of water is cut off. As a rule, these pools contained many larvæ. By connecting one pool with another throughout the length of a watercourse, it was often possible to dry the whole of these pools quickly; where this could not be done, oil was poured on the separate pools. After the water supply is cut off, a pool also remains in the bottom of each *jhalar*. These pools were dried out by emptying out the water with tins and buckets.

(*b*) Rained-formed pools. These are very numerous during the months of June and July. First, there are the large shallow ponds of water formed almost throughout the lines on the level plain after every shower of rain. In the Royal Artillery lines, the chief ponds of

this nature are formed on the parade ground, on the football ground, and near the Royal Artillery bazaar. As a rule, these superficial pools dry for the most part in 2 or 3 days, but if before the end of that time more rain falls they remain sufficiently long for larvæ to develop in them. By digging small channels in various directions, it was comparatively easy to drain these away into the irrigation watercourses, and this was done every time rain fell.

More dangerous breeding grounds are formed by the *surface drains* which exist throughout the lines. From the fact that these drains have little or no fall, rain accumulates in them for many days, and, after a week or less, they swarm with *anopheles'* larvæ. Owing to the large amount of water they contain, they are difficult to deal with. Some were dried out with buckets, and on others oil was poured. During 1902 the rainfall was a very small one, but in years of heavy rain a great deal of labour would be required to keep these drains free from larvæ.

(*c*) Permanent tanks and pools. One large tank near the Royal Artillery bazaar was filled in by the cantonment authorities. Over 250 smaller tanks and pools have been filled in by contract labour.

(*d*) Numerous other breeding places have been dealt with as they have been discovered. The small drains carrying off water from the baths, stand-pipes, etc., in which larvæ were frequently found, have been swept out regularly, tins and buckets kept full of water in the lines in case of fire have been emptied weekly, as have also the horse troughs and cisterns. The only breeding places which have not been dealt with in any way are the swimming baths. Numerous *anopheles'* larvæ were found in the two large swimming baths in August and September. As they take 3 days to empty and a fortnight to refill, it was difficult to suggest any effective method of preventing them from acting as breeding places.

The following details of the work are taken from my diary during the year :—

The operations were commenced under favourable circumstances, for at the end of March no adult *anopheles* could be found by careful search in the houses, and, as the irrigation water supply had been cut off for some time, there were comparatively few breeding places to be dealt with.

The first object was to get all the irrigation watercourses thoroughly cleaned out, and their edges made smooth and free from grass and weed. Twenty coolies, under a head man of the Canal Department, were engaged, and work on the watercourses was started on April 2. The fresh supply of water entered the

canals on April 9, and a very few *anopheles'* larvæ were found in them on the 13th and 14th. Some of the watercourses were almost hidden from view by thick pampas grass and branches of trees, which grew on their banks, and, as it was very necessary that this thick growth of vegetation should be cleared away as quickly as possible, so that the watercourses might be converted into clean channels, exposed to the sun and air, it was found desirable to employ a larger staff of temporary men to carry out this first work. From April 21 to the end of the month, therefore, between forty and fifty coolies were employed daily on the irrigation watercourses. By the end of April all the watercourses in the area of operations had been thoroughly cleaned out, all the grass growing on their banks had been cut down, and their edges had been made as smooth as possible. On April 20 the water supply of the canals was again shut off. As a result of this, many pools were left in the watercourses and in the *jhalars*. A few *anopheles'* larvæ and numerous *culex* larvæ were found in all these pools. Most of them were dried out by the men with tins and buckets, but, as an experiment, a few of the pools were covered with a layer of kerosene oil. This killed all the larvæ present in about 20 minutes, but, three days afterwards (on the 24th), young *anopheles'* and *culex* larvæ were again found in these pools. On the evening of April 24 heavy rain fell for some hours. This caused many pools throughout the area, and gave an indication of what pools would be most dangerous during the rainy season. A map of the more permanent pools was now made, and additional men employed to commence filling them in with earth. In the meantime the water of the superficial pools was drained away by digging small channels leading into the irrigation watercourses, and the more permanent pools were dried by bailing out the water with buckets, and throwing it on the open plain, where it would dry up quickly in the sun.

After all the watercourses had been dealt with for the first time in the manner described, two men were permanently applied to each branch. Their duties were :—

(1) To keep the edges free from grass and weed.
(2) To keep the sides smooth and regular by scraping away the earth at some places, and filling in any small bays and irregularities at others.
(3) To constantly remove all leaves, sticks, and other floating *débris*. For this purpose the men were provided with shallow round baskets, and, by walking in the water, scooping the basket along the edge underneath the surface, all the floating *débris* was collected and thrown out on the bank. This was a very important part of their work, for dead leaves were constantly

falling into the water from the trees above, and under their shelter larvæ were constantly found. If left alone, the leaves collected in a thick mass at each bridge, impeding the flow of water, and forming an excellent breeding ground for larvæ.

Two men could in this way go over their own branch three times daily. They were constantly supervised and directed in their work by myself, my hospital assistant, and by an overseer of the canal department.

The irrigation water supply started again on May 6, and was not shut off for more than two or three days at a time throughout the summer.

In spite of the constant cleaning operations, a few *anopheles'* larvæ, and a fair number of *culex* larvæ, were found in the watercourses on May 12.

By covering the shallow baskets with muslin, the men were able to catch and destroy a good number of these larvæ at the same time as they collected the leaves. On May 15 the bricking of the watercourse running through the centre of the lines was commenced, and for this purpose the water was shut off from this branch and the others which obtained their supply from it.

On May 14 slight rain fell, and the pools formed were treated in the same manner as on the same previous occasion. The filling in of permanent pools with earth and the cleaning of the watercourses was continued steadily, but in spite of this a certain number of *anopheles'* larvæ were found in all the watercourses from May 15 onwards.

Along the smooth edges they were not as a rule to be found, but in many of the watercourses roots of trees projected into the channel, and in their shelter larvæ were generally present. All the larger roots were therefore cut off to the level of the bank with hatchets, and so got rid of.

From May 30 to June 3 I made careful observations throughout the area of operations, and throughout another part of the cantonment, to ascertain whether any success in the reduction of the number of larvæ and adult mosquitoes had been attained. The results showed that although in the area of operations a few larvæ could be found in all the watercourses *by careful search*, the number present was far less than in the uncleaned watercourses in other parts of the cantonment.

In the watercourses of the British Infantry bazaar, for example, an enormous number of larvæ were found, and even without dipping with a tin they could be seen among the grass and weed at the edges. It was evident that up to the end of May the breeding of larvæ in the watercourses of the area of operations had been prevented to a very considerable extent. Corresponding success was attained with regard to the number of adult insects to be found in the houses. On June 3, after careful search for over an hour, I could not find a single adult

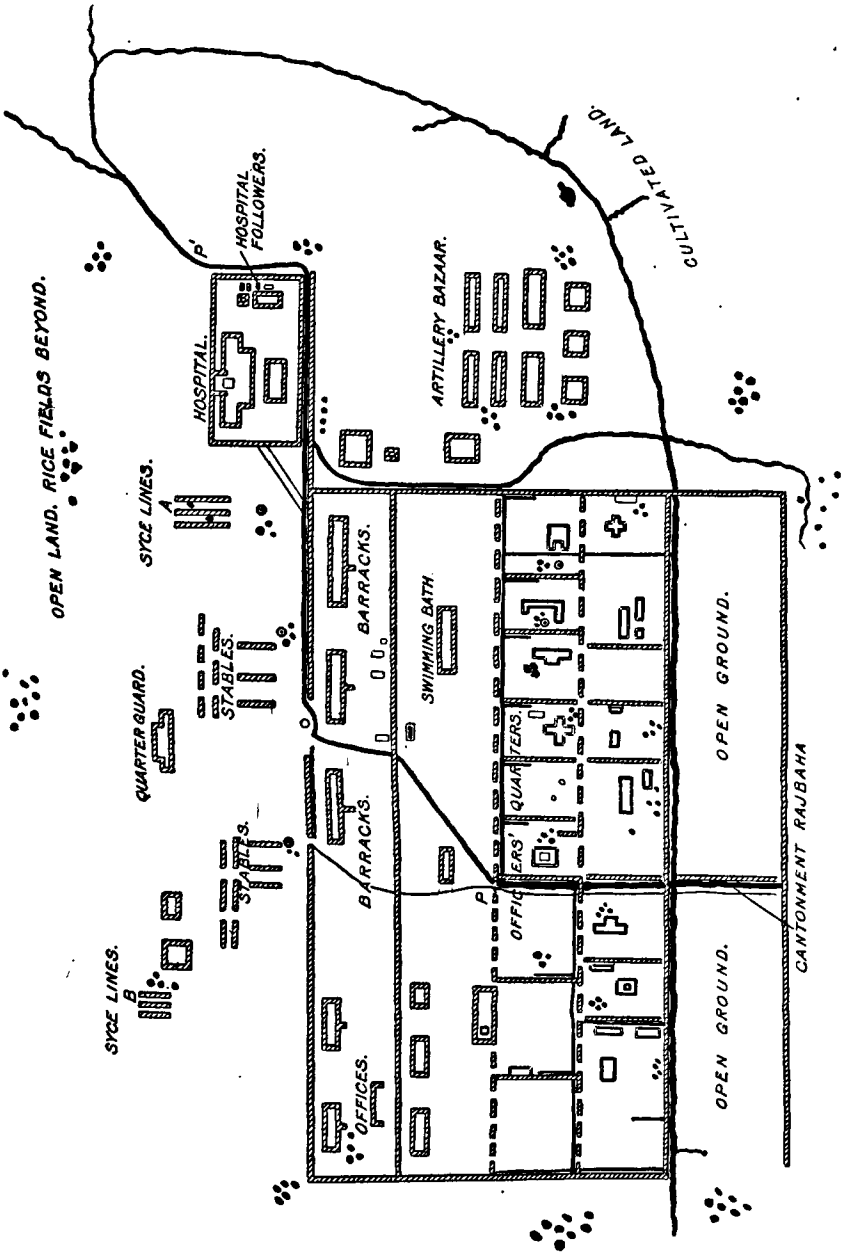
anopheles in the Royal Artillery bazaar. On the same day I caught ten adult *A. culicifacies* in the British Infantry bazaar in about half-an-hour without much difficulty. During June, however, the number of larvæ in the watercourses of the area of operations increased considerably, in spite of the same methods being continued. I have already mentioned that by reason of some of the watercourses having no outlet, the water in them is stagnant except for about 3 hours a day while the Persian wheels are working. However clean they are kept, they form, for this reason, prolific breeding grounds for *anopheles*. Finding that cleaning operations were not completely successful in preventing larvæ from appearing in large numbers in these watercourses, I tried the plan from June 15 of making a *bund** at the beginning of each branch, emptying out all the water in the branch, allowing it to dry in the sun, and again letting in fresh water (Method (*c*) pp. 47—48). By this means all the larvæ present in the branch at the time were killed. During the month of June I found that larvæ required 10 to 12 days to develop from the very young stage into adults, and to kill all larvæ it was, therefore, necessary to dry each branch about once every 10 days. I carried out this plan for six weeks, but on account of the expense of drying out the branches, which was done partly by working the Persian wheels, and partly by bailing out the water with tins and buckets, and the fact that such operations interfered to some extent with irrigation, I ceased this plan about the middle of July, and returned to the method of keeping the edges of the watercourses clean and removing all floating leaves and *débris*. From the beginning of June the operations carried on, and the results of examinations for larvæ and adult mosquitoes, may be more conveniently described under the headings of the various sections into which the area of operations was arbitrarily divided.

I. *The Watercourses.*

In the area of operations there are ten watercourses. As the methods employed and the results obtained were practically the same in all, it will be sufficient to give the details concerning one watercourse only, noting that similar operations were carried out on different dates in all the other watercourses, and practically similar results obtained. The following account refers to the first watercourse through the gardens.

On June 7 a fair number of nearly full-grown *anopheles'* larvæ were found in this branch. A *bund* was made at its commencement, and it was dried out and cleaned on the 8th. Fresh water was let in on the 9th, but on the 12th very young *anopheles'* larvæ were again present. The number and size of the larvæ found gradually

* Bund = a dam or embankment.



PLAN OF ROYAL ARTILLERY LINES.

increased, and on the 19th this branch contained a good many nearly full-grown larvæ. The water was therefore again shut off on the 20th, and the watercourse was dried and the mud it contained dug out.

As irrigation was not required from this branch at the time, fresh water was not let in until the 26th of June. Three days later a few very young larvæ were again found. Cleaning of the sides and removal of leaves was carried on daily, but on July 8 many young *anopheles'* larvæ and a few full-grown ones were found throughout its length. On July 9 the water was again shut off and the branch dried, but before the drying was completed the branch was refilled by rain on the 10th, so it was again dried and fresh water let in on the 13th. New broods of larvæ were not found again until the 17th. On the 22nd there was very little water in this branch, and numerous full-grown and young *anopheles'* larvæ were found in it. As the supply of water was so small that none could reach the Persian wheel, oil was poured on it, which killed all the larvæ. Sufficient water for irrigation did not reach this branch again until the beginning of August, and on August 9 young larvæ were found. Full-grown larvæ were not found until the 22nd, when this branch had again become so shallow as to form only a series of pools. These pools were dried out. With the return of the irrigation water supply, cleaning operations were carried on daily, but in spite of this, many full-grown larvæ and innumerable young ones were again found on August 31. With proper precautions to prevent any oil reaching the Persian wheel (*vide* Method (*d*) p. 48), I therefore covered the whole branch with a layer of kerosene oil. On the next day no larvæ at all were found. The good effect of the oil lasted about a week; on September 7, however, young *anopheles'* larvæ were again found, and on the 15th numerous full-grown larvæ. With the same precautions as before, oil was again poured on the first half of the branch on September 17, and on the 18th no larvæ were found except a few at the very end, where the oil had not reached. On September 24 a few very young larvæ were again found—the effect of the oil having passed off—and on the 28th, when the branch was so shallow as to form only a chain of pools, full-grown larvæ were present. These pools were dried out. At the beginning of October the irrigation water supply was cut off, and this branch was dry throughout its length on October 3. The supply recommenced on October 9, and young larvæ were found on the 14th. On the 22nd it contained a good many full-grown larvæ and some pupæ, but on this date the irrigation supply was again cut off, so that on the 23rd this branch contained only a few pools, which were easily dried out. On October 24 fresh pools were formed by rain, but on the 27th no larvæ were found in these pools and they were dry on the 28th. The irrigation supply was resumed on November 5, but it only ran for 3 days, and on the 11th, with the exception of some pools under the bridges, this branch was dry throughout. A few *anopheles'* larvæ were found in these pools. They were dried out, and together with all the other watercourses this one remained dry until the irrigation water supply was

again given on November 29. This branch had now been dry for fully 20 days, and as at this time no adult *anopheles* could be found in the houses, it afforded a good opportunity of testing whether any adults were really present (though none could be detected by careful search) or not. If adult *anopheles* were present in the houses, it is reasonable to suppose that they would again lay their eggs in the branch as they had done throughout the year. No young larvæ have, however, been found in this or any of the other branches from the time of arrival of fresh water on November 29 up to the present date. On December 5 the irrigation supply was again cut off and a chain of pools left in the branch. These were allowed to dry in the sun, and afforded exceedingly favourable breeding places, but no larvæ appeared in them or in the pools of any of the other branches.

A few details may now be given regarding the watercourse, which was rendered permanently smooth and free from grass and weed by lining it with bricks plastered with cement. The total length of the bricked portion is 4,985 feet. Before being bricked it formed an exceedingly dirty weed-grown ditch, containing almost stagnant water, running through the centre of the lines and within a few yards of the front of the barracks, the military prison and hospital (*vide* plan of Royal Artillery lines, PP'). In addition to its being a prolific breeding ground for *anopheles* it formed a depositing ground for most of the old tins, bottles, and rubbish of all descriptions from the lines and barracks. As a result of the bricking it has been converted into a clean-flowing channel about 5 feet wide and 4 feet deep, running with moderate velocity and in an efficient manner. A sliding door has been placed at its commencement, by means of which the flow may be regulated and the channel flushed out. The bricking was commenced on May 15, and completed at the end of July.

Although from a sanitary point of view the bricking of this watercourse has been of great benefit, the result, from the point of view of destruction of *anopheles'* breeding places, has not fully realised our expectations. We had hoped that after bricking this channel, the flow of water in it would be sufficiently swift to entirely prevent its acting as a breeding place. This, however, is not the case, and if left entirely alone, it still remains as a breeding ground of *anopheles*, though not nearly to the same extent as formerly. This is due partly to the fact that the flow of water is still only very moderate, and partly to the numerous leaves which fall into the water, and collect at the bridges, where they form a suitable shelter for larvæ.

During part of August I did no cleaning operations whatever on this watercourse, with the object of testing the efficacy of the work of bricking. Although no larvæ could, as a rule, be found along the clean, plastered sides of the channel, they were numerous at the bridges and under the leaves. After this I constantly employed two

men with baskets to take out all the leaves, and to keep the sides of the channel clean and free from mud. As a result of this the number of larvæ to be found was very much diminished, and it may fairly be said that, while the water is actually running, one or two men constantly employed in this way could keep this bricked watercourse almost completely free of *anopheles'* larvæ. When the irrigation water supply stops, however, a number of pools remain in this watercourse, as in the unbricked ones, and these would also require constant attention.

The above descriptions may be taken as fair examples of the methods employed, and the results obtained in all the watercourses of the area of operations. It will be seen that though various plans were carefully tried, it was not possible to prevent *anopheles'* larvæ from constantly appearing in the watercourses in large numbers. By continuous efforts it is possible to check the breeding to a certain extent, and to kill a great many of the larvæ, but if the measures are stopped for even a week at a time, the condition becomes almost the same as before.

II. *The Royal Artillery Bazaar Section.*

On June 11 no breeding places except the irrigation watercourses were found in this section. On the 17th a few *anopheles'* larvæ were found in a garden pool in front of the bazaar. This pool was dried out, and on the 22nd no breeding places were found. Search for adults was frequently made during June. On the 3rd no adult *anopheles* were found after careful search in many of the houses, stables, and sheds. On the 16th I found four adult *A. culicifacies* in one of the stables after nearly an hour's search. By the 26th the number of adult *A. culicifacies* present in the houses had increased considerably, but they were still scanty, and difficult to catch. This was in marked contrast to other bazaars in the cantonment, where from the beginning of the month adult insects (*A. culicifacies*) were present in sufficient numbers to be caught without much difficulty in many of the houses. No adult *A. Rossii* were caught in any of the bazaars during June.

During July a large number of rain-formed breeding places were found from time to time in this section. These consisted chiefly of large and small pools formed by holes dug for road making, building, and other purposes. Along one roadside there were twenty pools, averaging 5 feet long by 2 feet deep, which after a short time swarmed with the larvæ of *A. Rossii*. Such pools were temporarily covered with a layer of oil, and afterwards filled in with earth. The surface drains in this section were found also to afford excellent breeding places for *anopheles*, and during this month it required great care to keep them free from larvæ. Another class of breeding place found

during this month were the drains and pools formed by the waste water of the wells. This waste water of the wells is difficult to deal with, for it cannot be drained away on account of the levelness of the ground. In this section it was dealt with by collecting it into a temporary deep pool, which was kept constantly covered with a layer of oil.

During July, in spite of constant attention being paid to all breeding places, the number of adult insects (*A. culicifacies* and *A. Rossii*) found in the houses increased considerably, and throughout the month specimens of both species could be caught fairly easily at any time.

During August the chief breeding places found in this section were the roadside surface drains, the deep pools by the roadsides, the drains carrying off water from the wells and from the bazaar, a few irrigation pools in a garden in part of the bazaar, and the *gumlahs** of water kept outside each house. During part of the month the road in front of the bazaar was being relaid. In road-making it is the practice of the contractors to use the surface drain which runs at the side of the road they are laying as a reservoir of water. One end of the drain is closed by a barrier of bricks and earth, and the drain is then filled to the brim with water for use in their work. A collection of water 50 yards or more in length is thus made, which quickly becomes swarming with *anopheles'* larvæ. Within the limits of the cantonment the practice of filling these drains with water was stopped with some difficulty, as the workmen refused to continue laying the roads unless it was allowed. Outside the cantonment limit it was still carried on, and the constant emptying out of the water in these drains every few days required much labour. In the absence of urgent work of this kind, my men were employed filling in the roadside pools with earth. In the meantime all pools were kept covered with a layer of oil. In this month it was found necessary to repeat the oiling of pools at least every three days, as the larvæ developed so rapidly, and under the great heat the oil quickly evaporated.

During the month of August a very large number of adult *A. Rossii* were present in the houses of the bazaar. The number of adult *A. culicifacies* had also increased somewhat, though they were not by any means as plentiful as *A. Rossii*, nor were they so common as in other bazaars of the cantonment where no operations had been carried on.

During September and October the same class of breeding places had to be dealt with. Most of the pools had by this time been filled in with earth, and as the rains had almost ceased the work was less. Constant inspection, however, was necessary to keep larvæ from appearing in every collection of water in and around the bazaar. *Gumlahs* of water had to be constantly emptied, shallow drains to be swept out, and a layer of oil kept constantly on overflow pools of the

* Gumlahs = earthenware vessels.

wells and other collections of water that could not be dealt with in any other way. During September the filling in of a large pond near the bazaar was completed by the cantonment authorities.

At the beginning of September there was a temporary diminution in the number of adult insects to be found in the houses, but at the end of the month, and during October, their numbers were certainly as great, if not greater, than during August.

A few specimens of other species, viz.: *A. Stephensi*, *A. pulcherrimus*, and *A. fuliginosus*, were also found during September.

During November the development of larvæ was less rapid, and the number to be found in the different breeding places gradually diminished. A progressive decrease in the number of adult *anopheles* to be found in the houses also occurred, and at the end of this month it was difficult to catch any specimens of either species.

At the beginning of December no adult *anopheles* of any kind could be found in the houses, and from this time onwards no fresh batches of larvæ have appeared in any of the breeding places. A similar disappearance of adults and larvæ was, however, noted in other parts of the cantonment where no operations had been carried on.

III. *The Barracks Section.*

On June 4 *anopheles'* larvæ were found in the shallow drains carrying off water from the swimming baths, and in the overflow water of the stand-pipes. A sweeper was appointed to keep all the shallow drains in the vicinity of the barracks swept out daily. On the 14th *anopheles'* larvæ were found in shallow pools near the Persian wheel of the fourth Branch, and in its stone water reservoir. On the 24th *anopheles'* larvæ were found in a number of kerosene oil tins which are kept full of water near No. 8 Barrack, and on the 30th larvæ were found in the stone water reservoirs of the cook rooms.

Adult *anopheles* (*A. culicifacies*) were first found in the barracks on June 16. Throughout the month, however, the number of adult insects in the barracks was very small. No *A. Rossii* were caught in the barracks during June.

During July rain-formed breeding places were abundant in this section; all the storm-water surface drains especially formed good breeding grounds for *A. Rossii*. After each shower of rain, also, large areas of water collected in many parts of the lines, and a number of deep trenches which had been made to mark off the boundary of the cantonment grass farm area also became filled with water, which in two or three days swarmed with larvæ. The shallow collections of surface water were drained away into the irrigation canals. Collections of water in pools, drains, or trenches were either emptied out, or covered with a layer of oil.

The number of adult insects found in the barracks increased quickly during this month. On July 8 large numbers of *A. Rossii* were collected from the barracks and harness rooms, and on the 11th these rooms also contained a fair number of *A. culicifacies.* Throughout the month, however, the number of adult *anopheles* present in the barracks and other parts of this section was not nearly so great as in parts of the cantonment where no operations had been carried on.

The following is a list of the places where *anopheles'* larvæ were found in this section during August:—

(1) Numerous waste-water pools from stand-pipes, cook-houses, and wells.
(2) Small brick drains leading away from the above.
(3) Numerous rain-formed pools in the surface (storm-water) drains, and on the open plain.
(4) Tins of water kept near the barracks and hay-ricks in case of fire.
(5) The swimming baths.

These breeding places (except the swimming baths, for which no method could be devised) were dealt with regularly. During the month the number of adult *anopheles* present in the barracks increased considerably.

The breeding places during September and October were similar to those in August, and had to be regularly dealt with, the section being gone over weekly for this purpose.

The number of adult insects to be found in the barracks was greatest during these two months.

During November the number of adults and larvæ gradually diminished, and by the end of the month no adults could be found, and no fresh batches of larvæ appeared in any of the breeding places.

IV. *The Stables Section.*

This section is an extension of the previous one, and as it contains a similar class of breeding place, it is unnecessary to record the operations regarding it in detail. It should be mentioned, however, that during August *anopheles* larvæ were found on several occasions in two wells in this area which were not often used. The level of the water in these wells was about 30 feet from the surface.

V. *The Garden Section.*

This is chiefly a record of numerous pools formed in the gardens of the officers' houses, as the result of irrigation or of rain. From the commencement of the operations the surroundings of each bungalow were carefully examined at least once a week, and all breeding places

dealt with. Several of the officers themselves assisted in doing away with all breeding places in their compounds, and in killing all larvæ found with kerosene oil. In spite, however, of constant attention to all breeding places, adult *anopheles* could always be found in the bungalows and in the servants' quarters.

In several of the compounds as many as twenty pools containing *anopheles'* larvæ would be found at each examination, as well as small drains, iron cisterns, and the stone water reservoirs which are present in the garden of every Indian bungalow, and although all these breeding places were effectively dealt with at each examination, in less than a week they had nearly all re-formed, and become again swarming with larvæ.

One of the most difficult breeding places to deal with in this section was the waste water from the garden wells, which formed a small marshy area round the well in which *anopheles* bred freely. Wherever possible this water was drained or swept away, but in most compounds frequent application of oil was all that could be done.

Other difficult breeding places to deal with in this section were the pools of water round the roadside trees. As these pools are replenished daily by a fresh supply of irrigation water, before they have completely dried up they form favourable breeding places.

VI. *The Pools Section.*

It is unnecessary to enter into detail regarding the numerous rain-formed pools which had to be dealt with during the months of June, July, and August. The following extract from my diary will, however, give some idea of the number of pools formed by a rainfall of two hours duration on July 27.

"On the 28th July, as the result of two hours' rain yesterday, the following pools which will remain sufficiently long for the development of larvæ were found in the area :—

(1) 40 pools between 2 and 3 feet deep beyond the hospital.
(2) 12 ditches surrounding grass land beyond the hospital.
(3) 24 pools about 3 feet deep and 3 large ones about 4 or 5 feet deep beyond the Syce lines.
(4) 21 smaller pools, which will probably dry up in 3 or 4 days, between the Syce lines and the barracks.
(5) 6 very large pools and 8 smaller ones at the rifle butts. (The large pools are about 12 yards long by 10 yards wide and about 4 feet deep.)
(6) 5 large pools, 3 smaller ones, and two ditches near the Persian wheel of the fourth watercourse.
(7) 3 large pools near the last part of the fifth watercourse.
(8) 5 large shallow pools in the Royal Artillery bazaar, 10 of the

same kind near the Right Battery stables, and 3 near the Left Battery stables.

(9) A group of large pools near the Police guard.

(10) 22 deep roadside pools behind the Royal Artillery bazaar."

In addition to these, most of the surface drains were full of standing water, and innumerable small pools and broad collections of water covered the area on every hand.

Rain fell again on the 1st, and again on the 3rd of August, so that even the smaller pools had no opportunity of drying up for a week or more.

Large number of *anopheles'* larvæ were found in all these pools, and even in the broad shallow collections of water on the open plain as early as two days after their formation. As soon as larvæ were found in a pool, it was covered with a layer of kerosene oil, or dried out and marked to be filled in with earth.

By the end of October over 250 of the larger-sized pools had been filled in with broken bricks and earth.

The above is a brief account of the operations against mosquitoes carried out during the summer of 1902. The greater part of the work of filling in pools and emptying out water from the surface drains was done by contract labour, so as to avoid the necessity of constantly watching the coolies to see that they were working properly, thus leaving myself and my hospital assistant more time for searching for new breeding places. Work of this kind is also done much more quickly and less expensively by putting it out on contract than by employing a large number of coolies on a stated daily wage. My object was as far as possible to deal permanently with each breeding place as it was found, so as to avoid having to repeatedly deal with the same breeding place. This, however, can only be done with a limited number of permanent pools, and the chief difficulty met with in Mian Mir arises from the fact that the bulk of the breeding places require constant and regular attention throughout the summer.

Operations during the Winter (1902—1903).

I have already mentioned that the number of larvæ to be found in all the breeding places, and the number of adult insects present in the houses, gradually decreased during November, until by the end of the month I was not able to find any adult insects in the houses, and no new batches of *anopheles'* eggs or larvæ appeared in any of the breeding places. It was necessary to find out whether the disappearance of adult *anopheles* was complete, or whether a certain number still

remained in the houses in a "hybernating" condition throughout the winter, ready to lay their eggs when the warm weather came again in the spring. During December and January I made experiments to test this point. In the first place, I allowed all favourable breeding places to remain untouched during December. If any adult female *anopheles* were really present in the houses, it was almost certain that some of them at least would occasionally come to the pools and lay their eggs, as they had always done during the summer, for though the nights during December were very cold, the days were still warm and sunny. That *anopheles* if they are present in a place will lay their eggs during December in the Punjab is proved by the fact that a few adult *anopheles* caught at Ferozepore at the end of December readily laid eggs on January 1. During December, however, not a single *anopheles'* egg or young larva was found in any of the breeding places in the area of operations at Mian Mir. This is strong evidence, therefore, that all adult *anopheles* had disappeared from the area.

Further proof was afforded by the following experiment:—

Having chosen a house in which abundant adult *anopheles* has been constantly found during the summer, I covered the floor with a sheet, and having carefully closed all outlets, four or five cones composed of a mixture of nitrate of potash, charcoal, sulphur, and pyrethrum powder were burnt in the house for three hours. During the summer I had proved that two of these cones burnt in a house of the same size were sufficient to kill all the *anopheles* it it. In December, however, not a single dead *anopheles* was found on the sheet spread on the ground, This experiment was repeated in a number of houses, stables, sheds, arches of bridges, and other places in which it appeared probable adult *anopheles* might hybernate through the winter.

Numerous *culex* (which were very plentiful in December and January, and laid their eggs regularly in the breeding places) were killed by this method, but no *anopheles*. I conclude, therefore, that all *anopheles* had disappeared from the area by the beginning of December.

This disappearance cannot, however, be attributed to the operations, for a similar disappearance was noted in other parts of the cantonment where no operations had been carried on, and the same almost sudden disappearance had been noted by us at the end of November, 1901.

It should be mentioned that in parts of the cantonment where no operations had been carried on, and in Lahore (4 miles from Mian Mir) *anopheles'* larvæ could still be found in permanent breeding places throughout the months of December and January. These larvæ, however, are not newly hatched ones; they are old larvæ which were hatched in October and the first part of November, but which on account of the cold are not able to develop into pupæ and adults until the spring. They remain alive in a sluggish condition throughout the winter, and form without doubt one means by which *anopheles* can tide

over the cold of winter and re-appear in the spring. My object during the winter has been to kill off all these "hybernating" larvæ throughout as wide an area as possible round the Royal Artillery lines. Up to the middle of January this had been done within a radius of a mile in every direction from the lines. If *anopheles* appear in any number in the area in the spring, it must mean that they have come in from a distance of at least a mile, for we may say with some certainty that no adults or larvæ exist at the present time within this distance of the area.

II. *Other Operations.*

I have already mentioned that the native children in the different followers' lines and in the Royal Artillery bazaar form the chief source from which *anopheles* mosquitoes become infected. It was desirable, therefore, as far as possible to minimise the effect of these large sources of mosquito infection. The measures by which this could be done were—(1) The removal of the infected children from the vicinity of the barracks, or—(2) The treatment of all infected children with quinine.

The nearest and most heavily infected body of children were those in the Syce lines of the Right Battery. These Syce lines contained about 78 children, and in October, 1901, over 56 per cent. of them had malaria parasites in their blood. The distance of these lines from the barracks of the men is less than 180 yards. Arrangements were made to have the inhabitants of these lines removed into tents on a site half a mile away from the nearest barrack, and this measure was carried out in August. By this means the most dangerous source of infection of *anopheles* was undoubtedly done away with.

The second dangerous source of infection of *anopheles* was afforded by the children in the hospital followers' quarters, which are situated at the back of the hospital compound about 40 yards from the hospital and prison, and about 400 yards from the main barracks of the troops.

It was found impracticable to have the hospital followers and their families moved into new quarters at a distance from the hospital, and I decided, therefore, to treat all the children regularly with quinine. They numbered 34 in all. The treatment was commenced on August 30, and each child received a dose of from 5 to 10 grains of quinine, according to age, once a day for the first ten consecutive days, and afterwards a dose of 10 grains of quinine twice a week throughout September, October, and November. In the middle of October when in spite of the treatment a few new infections occurred among the children, ten days consecutive treatment was again given to those children in whose blood parasites were found, and again at the end of November, when the season of new infections had passed, all the children were again given ten days' consecutive treatment in order

to completely kill off any parasites which might still have resisted the previous treatment.

It was found that even children of one or two years of age could stand a daily dose of 10 grains of quinine without any ill effect. After the first three or four days most of the children took the quinine readily and apparently got to like the bitter taste.

The third and fourth sources of infection of *anopheles*, in order of importance, were the Royal Artillery bazaar and the second series of Syce lines.

Mosquito destruction was the only prophylactic measure carried out in the Royal Artillery bazaar, as it was necessary to keep one body of children untreated with quinine in order to test the efficacy of the operations against mosquitoes.

The children of the second series of Syce lines, which are situated at a distance of 400 yards from the nearest barrack, were infected with malaria parasites to the extent of 20 per cent. in October, 1901. From September 10 to the end of November, 1902, they were regularly treated with quinine in the same manner as was being done with the hospital followers' children. They numbered 103 in all, and each child received a daily dose of from 5 to 10 grains of quinine for the first ten days, and afterwards a dose of 10 grains twice a week on consecutive days.

Prophylaxis by the Administration of Quinine to the Troops.

In addition to the measures described above, all the British soldiers in the cantonment received a dose of 10 grains of quinine twice a week on consecutive days. The chief object of this measure was to prevent relapses of old infections. We have found that at the end of November, 1901, 22·2 per cent. of the men of the Royal Artillery who were doing their duty and who were apparently quite healthy, had malaria parasites in their blood, so that it was evident some measure by which relapses of these infections might be prevented was necessary. The administration of quinine was commenced on April 18, and continued throughout the summer.

Part III.—Results.

In considering the results of the operations up to the present time, we may take first the results obtained with regard to the prevalence of *anopheles* mosquitoes.

On this important point the following conclusions must, I think, be admitted :—

(1) The operations were commenced at a favourable time when very few, if any, adult *anopheles* were present in the houses, and very few, if any, larvæ in the breeding places.

(2) In spite of the operations, the number of larvæ found in the breeding places, and the number of adults present in the houses gradually increased month by month to a maximum in September and October, and then quickly decreased during November and the beginning of December, in spite of the operations being discontinued during the latter month.

(3) As a result of the operations, the increase in the number of *anopheles* which occurred each month was to a great extent checked, so that the actual number of *anopheles* present in the houses at any time during the year was not nearly so great as it would have been had no operations been carried on.

(4) In spite of the check on the breeding of *anopheles*, the actual number present in the houses from July to November was such that specimens of both species, *A. culicifacies* and *A. Rossii*, could be caught fairly easily at any time.

(5) Within the area of operations the number of adult specimens of *A. culicifacies* present in the houses was less than in other parts of the cantonment where no operations had been carried on.

(6) The number of adult specimens of *A. culicifacies* present in the houses of the area during the year of operations was less than during the preceding year. This cannot be said with certainty regarding parts of the cantonment (*e.g.*, the British Infantry bazaar) where no operations were carried on. If in these other parts any difference between the number of *A. culicifacies* present in the houses in 1901 and 1902 existed, it was so slight as not to be detectable by searching. In the Royal Artillery bazaar, however, it was quite evident to one who had regularly searched the houses during both years, that a measurable reduction in the number of *A. culicifacies* had been effected.

(7) The number of larvæ of *A. culicifacies* to be found in the cleaned canals and watercourses was certainly less than in the uncleaned ones, and for this reason less than could be found during the preceding year.

(8) Regarding *A. Rossii* it cannot be said with certainty that the number of adult specimens present in the houses within the area of operations was less than in other parts of the cantonment, nor, in my opinion, was the number of this species to any marked extent less than in the preceding year. In 1902, as in 1901, this species was so abundant in all parts of the cantonment that any difference which existed was negligible. Except on the supposition that they came from some place outside the area of operations, which extended to a distance of nearly half a mile in every direction from the houses

where the adult insects were caught, it is difficult to account for the almost sudden appearance of large numbers of this species which occurred at the beginning of July. It is also difficult to account for the fact that in spite of all breeding places of this species within the area being regularly dealt with, the number of adult insects present in the houses increased very greatly instead of diminishing.

It is evident, therefore, that the problem of materially reducing the number of *anopheles* in Mian Mir is a difficult one. As a result of the operations a reduction in the number of the malaria-carrying species (*A. culicifacies*) has been effected, but the reduction is not sufficient to prevent specimens of this species from still being found fairly easily in the houses, which means that they are present in fair abundance.

The chief difficulty lies in the fact that the majority of the breeding places in Mian Mir are such that they cannot be permanently done away with, and it seems doubtful whether any operations short of permanent elimination of all possible breeding places will produce a marked reduction in the number of *anopheles*. It should be remembered, however, that the operations have only been in progress about nine months, and that by continually rendering all possible breeding places inhospitable for larvæ, a permanent diminution may in time be effected. It is impossible also to predict what effect will be produced by the winter operations, during which I hope to be able to kill off all larvæ within a wide distance of the area of operations, and assuming that my observation regarding the complete disappearance of all adult *anopheles* from the area is correct, it will be interesting to note by what means adult insects re-appear in the area in the spring.

Secondly, we may consider whether any reduction in the amount of malaria has been effected, and if so the means by which this has been brought about.

In order of importance the tests of a reduction in the amount of malaria are:—

(1) A reduction in the amount of malaria in the regimental bazaars as measured by the percentage of young children found infected with malaria parasites.

(2) A reduction in the percentage of infection with malaria parasites among the troops.

(3) A reduction in the number of admissions for "ague" among the troops.

I.—The Amount of Malaria in the Regimental Bazaars.

1. *The Royal Artillery Bazaar.*

In this bazaar mosquito destruction was the only prophylactic measure carried out.

The percentage of infection of the children, and their spleen rates at the height of the fever season in 1901 and 1902, are shown in the following table:—

Royal Artillery Bazaar.

	October, 1901.	October, 1902.
Percentage of infected children	35	20
„ with enlarged spleens	75	64

In the year of operations, therefore, there was a reduction in the amount of malaria in this bazaar.

It should be noted, however, that in the British Infantry bazaar, where no operations were carried out and which was kept for the purpose of control observations, a reduction in the amount of malaria also occurred during 1902. This is shown in the following table:—

British Infantry Bazaar.

	October, 1901.	October, 1902.
Percentage of infected children	52	42·3
„ with enlarged spleens	80	69

It may be assumed, therefore, that a reduction in the percentage of infected children of the Royal Artillery bazaar would also have occurred in 1902 in the ordinary course of events and in the absence of any operations.

A closer examination of the figures shows, however, that over and above the decrease which would have occurred in 1902 in consequence of the year being an unusually healthy one, there was an additional decrease which may fairly be ascribed to the operations against mosquitoes. The decrease which occurred in the British Infantry bazaar in the absence of any operations is represented by the proportion as 1·23 : 1, and the decrease in the Royal Artillery bazaar, where mosquito destruction was carried on, is represented by the proportion as 1·75 : 1, a much greater decrease than can be accounted for solely by the fact of the year being an exceptionally healthy one.

The difference between the relative decrease of the spleen rates in the two bazaars is not so marked, being represented by the proportions as 1·159 : 1 in the British Infantry bazaar, and as 1·171 : 1 in the Royal Artillery bazaar respectively; but this is accounted for by the fact that in places where there are a large number of chronically-enlarged

spleen cases, even in the entire absence of new infections, it takes many months for the spleen rate to diminish very markedly.

The difference between the percentage of infected children in these two bazaars in September was much greater than in October, and it is reasonable to conclude from the following table that the onset of the season of greatest liability to infection had, as a result of the operations against mosquitoes, been delayed, and that the season had been shortened in the Royal Artillery bazaar.

Table showing the Percentage of Infected Children during some Months of the Years 1901 and 1902 in the Royal Artillery Bazaar and in the British Infantry Bazaar respectively.

	Royal Artillery Bazaar.	British Infantry Bazaar.
October, 1901	35	52·0
November „	—	22·0
December „	29	—
April 1902	21	—
June „	5	8·3
July „	4	8·5
August „	4	15·0
September „	4	32·2
October „	20	42·3
November „	12	27·0

We may fairly conclude, therefore, that purely as the result of a reduction in the number of *anopheles* (*A. culicifacies*), a reduction in the amount of malaria in this bazaar occurred. We have already seen that the reduction in the number of *anopheles* in this bazaar was not very marked, though it was quite apparent to one who had regularly searched the bazaar during both the years of observation. Had it been possible to have effected a greater diminution in the number of *A. culicifacies*, there is little doubt that the amount of malaria would have been reduced to a far greater extent. *The experiment shows that even a slight reduction in the number of anopheles affects the amount of malaria to an extent which is quite measurable.*

2. *The First Series of Syce Lines.*

The operation carried out with regard to these lines was the removal of all the inhabitants into tents on a new site.

The results of this experiment were very striking.

The old site was situated within 140 yards of an irrigation water-course, in which numerous *anopheles* (*A. culicifacies*) were breeding, and many adult insects of this species were present in the houses in

October, 1901. At that time 56·5 per cent. of the children were found infected with malaria parasites.

The new site was situated on the open plain, three-quarters of a mile from the nearest irrigation watercourse, and over 600 yards from the nearest pool, and as a result of this no adult *anopheles* were found in any of the tents during September and October of the year of operations.

Throughout the season not a single case of fever occurred among the adults in these tents, and on October 24 (at the height of the fever season) parasites were found in only 1 child out of 25 examined. Thus by their removal from the vicinity of *anopheles'* breeding places, and without treatment of any kind, the percentage of infection of these children had been reduced from 56·5 in October, 1901 to only 4 in October, 1902. Their spleen rate also had decreased from 75 per cent. in April, 1902, to 60 per cent. in October, 1902.

This experiment affords a good proof that if it is possible to do away entirely with breeding places of *anopheles* in any place, malaria quickly disappears. It should be mentioned that in every respect other than proximity to breeding places of *anopheles*, this body of people were under the same conditions in the new site as they had been in the old, except that being in tents they were more exposed to the sun and rain than they had been in their houses on the old site.

3. *The Hospital Followers' Lines.*

The measure carried out in these lines was the treatment of all the children with quinine. These children were not examined in October, 1901, but judging from the fact that in June, 1902 (the month in which malarial fever is least prevalent in Mian Mir) 60 per cent. of the children had enlarged spleens, it is reasonable to conclude that had they been examined during the fever season of 1901, a large proportion would have been found infected. In the middle of August, before quinine treatment was commenced, I found parasites in 2 out of 25 children examined. The treatment was commenced on August 30, and September 15 I was unable to find parasites in slides from any of 25 children examined, nor again in the same number examined on October 6. On October 24, however, I found parasites in 4 children out of 25, that is, at the height of the fever season 16 per cent. of the children were infected in spite of the treatment. These new infections, however, were quickly cured by daily treatment for 10 days, and I consider that this source of infection of *anopheles* was greatly minimized, if not entirely eliminated. Probably a certain number of *anopheles* became infected from these children before the treatment was commenced, and another year it would be advisable to begin it earlier in the year. The effect of the treatment on the spleen rate is shown in the following table :—

To show the Effect of Quinine Treatment on the Hospital Followers' Children. (Total number = 34.)

		Total number with enlarged spleens.
August	30	18
September	9	13
„	29	12
October	6	9
„	20	13
November	4	12
„	24	8

4. *The Second Series of Syce Lines.*

Quinine treatment was also carried out on the children in these lines.

At the height of the fever season in October, 1901, 20 per cent. of these children had been found to be infected with malaria parasites. As a result of the quinine treatment I was unable to find parasites in any of 25 children examined in October, 1902. The effect on the spleen rate is shown in the following table:—

To show the Effect of Quinine Treatment on the Children of the Syce Lines. (Total number = 103.)

	Percentage of Enlarged Spleens.
October, 1901	20·0
September 1, 1902	15·5
„ 29, 1902	2·9
October 10	4·9
November 15	3·9
„ 25	1·9

III.—The Number of Admissions for Malarial Fevers among the Troops.*

It is generally agreed that the year 1902 was an exceptionally healthy one for all troops in the Punjab, and for this reason it was an unfavourable year for testing the efficacy of prophylactic measures by means of hospital statistics.

The number of admissions for ague among British troops throughout

* I regret that, from want of time, I have been unable to carry out the second test, viz., the examination of films of blood from a large number of men in the British Infantry and Royal Artillery, in order to ascertain whether a reduction in the percentage of infection of the troops themselves has taken place.

the cantonment of Mian Mir was, I understand, the lowest ever recorded in this station.

The following tables have been furnished me by the senior medical officer, Mian Mir.

Table I.—Statement of the Admissions and Deaths from Malarial Fevers among the British Troops at Mian Mir for the Five Years 1898 to 1902.

Years.	Strength.	Admissions.	Deaths.	Ratio per 1000.	
				Admissions.	Deaths.
1898	869	702	1	808	1
1899	853	400	1	469	1
1900	814	871	2	1079	2
1901	808	1094	1	1354	1
1902	731	197	1	269	1

As shown on p. 31, the average annual admission rate per 1000 for malarial fevers in Mian Mir is 663, and the rate of only 269 for 1902 compares very favourably with this.

Table II.—Statement showing separately the Admissions and Deaths from Malarial Fevers among the British Infantry and the Royal Artillery in Mian Mir for the Years 1900—1902.

Years.	Corps.	Strength.	Admissions.	Deaths.	Ratio per 1000.	
					Admissions.	Deaths.
1900	Royal Artillery	259	132	1	509	4
	British Infantry	555	746	1	1344	2
1901	Royal Artillery	225	346	1	1538	4
	British Infantry	583	748	0	1283	0
1902	Royal Artillery	172	66	0	384	0
	British Infantry	559	131	1	234	2

e III.—Statement showing the Number of Admissions for Malarial Fevers into the British Infantry and Royal Artillery Hospitals monthly during 1902.

British Infantry Hospital.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Average monthly strength	690	651	667	507	335	321	308	306	314	893	955	601
Admissions.....	15	19	13	5	10	4	3	0	0	31	25	7

Royal Artillery Hospital.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Average monthly strength	*	*	98	311	298	287	276	267	272	263	*	*
Admissions.....	..	..	4	5	4	8	1	1	2	12		

Table IV.—A Comparison of the Admissions for Malarial Fevers during 1901 and 1902.

Hospital.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
British Infantry	1901	144	61	67	35	61	53	15	32	46	58	116	65
	1902	15	19	13	5	10	4	3	0	0	31	25	7
Royal Artillery	1901	20	2	3	6	38	33	22	42	44	75	40	16
	1902	*	*	4	5	4	8	1	1	2	12	*	*

* The regiment was absent from the station.

It is evident from these tables that, during the year 1902, the prevalence of malarial fevers among the troops in Mian Mir, as shown by statistics, has been remarkably less than in previous years. It is difficult to determine accurately the factor to which most credit should be given for this great decrease in the admission rate—a decrease which was equally notable in the British Infantry lines where no operations against mosquitoes were carried on, and in the Royal Artillery lines, which were within the area of these operations. In the first place, the year 1902 was, as a whole, far more healthy than 1901. Regarding this, we have the figures for the British Infantry bazaar as an indication of the difference between the two years. At the height of the fever season in 1901, the endemic index of this bazaar was 52 and the spleen rate 80 per cent. At the same time in 1902 the endemic index was 42·3, and the spleen rate 69 per cent. There was certainly, therefore, a marked difference between the two years, but not, in my opinion, a difference sufficient to account entirely for the large decrease which occurred in the admission rate of the British Infantry. A large proportion of the immunity enjoyed by these regiments, therefore, must be attributed to the prophylactic issue of quinine (which was carried out during 1902 under strict supervision), for no other prophylactic measures than this were undertaken in the British Infantry lines. In former years it has been usual to issue the quinine in bulk from the hospital to a non-commissioned officer of the regiment, and no control was exercised to see whether the men took the quinine or not. It is probable that not one man in ten ever took the quinine, for very few European soldiers will take this drug if they can possibly avoid doing so. During 1902, however, all the troops were marched to the hospital twice a week, and the quinine was given under the supervision of a medical officer, so that the majority of the troops, at any rate, took the prophylactic dose regularly.

To this fact, therefore, I attribute in large measure the low admission rate for malarial fevers among the British Infantry.

A certain margin must also be allowed for errors in diagnosis. I am informed that during 1901 it was the rule to admit every case of fever at once and return it as "ague." During 1902 much greater care was taken in diagnosis, and it is even possible that, in the British Infantry hospital, a few cases, which were really due to malarial fever, were returned under some other heading; for it is difficult to believe that, during August and September, not a single case of malarial fever should have occurred among over 300 men at a time when the endemic index of the regimental bazaar was increasing rapidly (15 per cent. in August and 32 per cent. in September), and when, from the reports of British officers living in the lines, a large number of native servants were suffering from malarial fever.

The events which happened in 1902 render it very difficult to form a correct estimate from the hospital statistics of the efficacy of the operations carried out in the Royal Artillery lines. These events were the arrival of a second regiment into the British Infantry lines at the beginning of October, and the departure of both batteries of Royal Artillery to Delhi at the end of that month. From the beginning of October, also, the Royal Artillery hospital was made a sick depôt, to which men who fell ill on the line of march to Delhi at other places than Mian Mir were returned. The twelve admissions recorded into this hospital in October (Table III) consisted chiefly of such cases as these, as well as of chronic malarial cases transferred from hill stations. For the same reasons the statistics of the Royal Artillery hospital show 9 admissions for malarial fever out of a strength of 54 during November, and 16 admissions out of a strength of 47 during December.

The inclusion of these figures in the annual return of Table II has made it appear that the ratio of admissions per 1000 among the Royal Artillery was greater during 1902 than that among the British Infantry. (Table II. Ratio of admissions of the Royal Artillery = 384 per 1000; of the British Infantry = 234 per 1000.)

Where so many factors affect the statistics it is, in fact, impossible to obtain any results of value from their consideration. It is, however, a matter for congratulation that, although during 1900 and during 1901 the death rate for malarial fevers among men of the Royal Artillery was much higher than among the British Infantry, during 1902 the results are reversed in favour of the Royal Artillery (*vide* Table II).

A few words may be added regarding the respective value of the different methods of prophylaxis attempted in Mian Mir.

That mosquito destruction, if it can be carried out successfully, will effectually banish malaria, is, I think, sufficiently proved by the results obtained in the Royal Artillery bazaar and in the first series of Syce lines (pp. 68—70). Even though it was not possible to reduce the number of *anopheles* very markedly in the Royal Artillery lines, a decrease in the amount of malaria in the Royal Artillery bazaar greater than can be accounted for, by reason of the year being an unusually healthy one, was effected. This decrease can only be attributed to the operations against mosquitoes.

In the Syce lines, which by their removal were taken entirely out of the range of *anopheles*, malaria almost entirely disappeared.

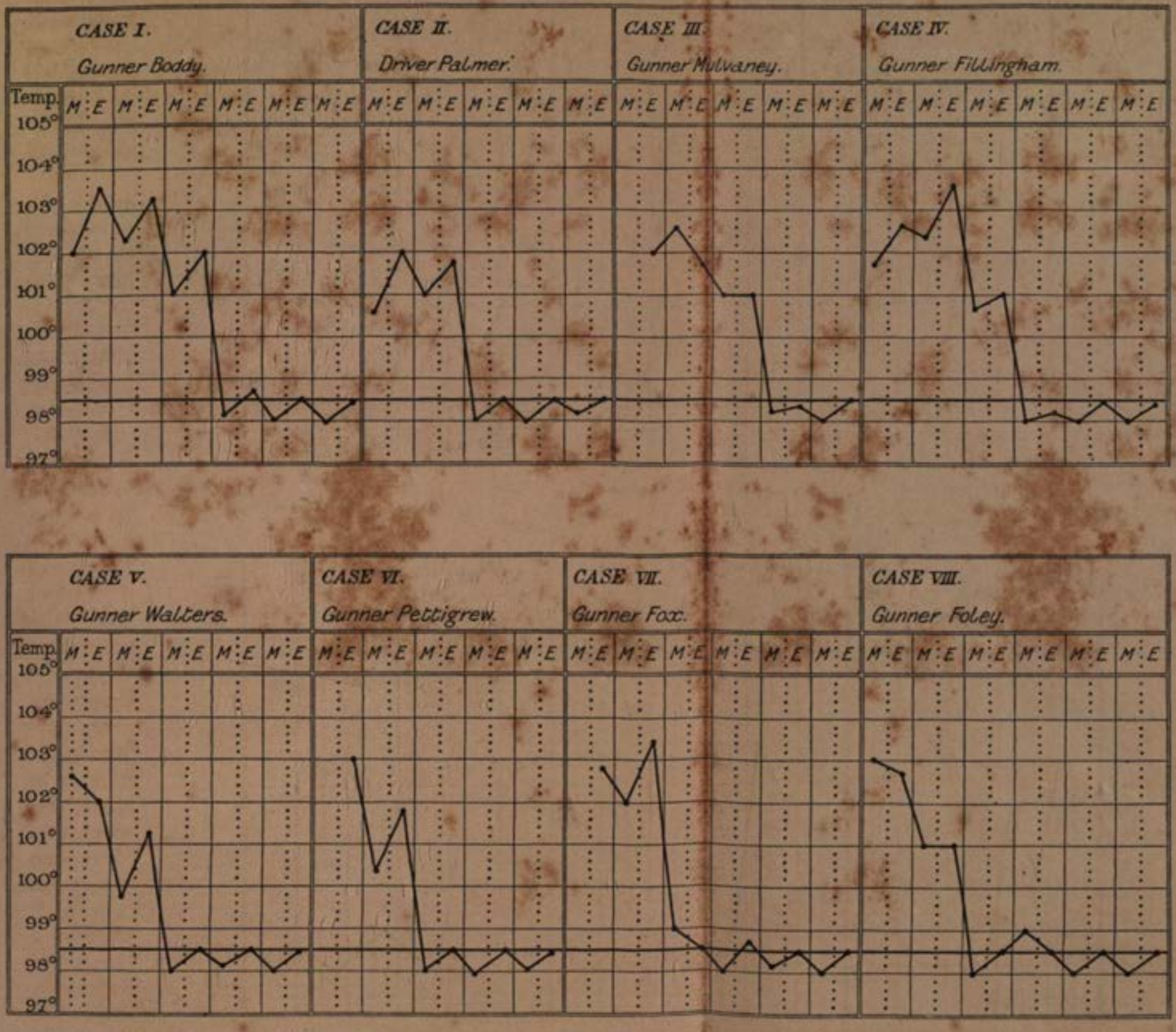
From a practical point of view the chief drawback to mosquito destruction is its difficulty and expense. It must be admitted that although we have been given, practically speaking, a free hand in

matters of expenditure and in the amount of labour employed, and although my own services and those of a hospital assistant have been confined exclusively to this work, we have, during the summer, made but little impression on the number of *anopheles*. It remains to be seen what the results of the winter operations, and those of the coming summer, will be; but unless a more marked reduction in the number of *anopheles* can be effected this year than during the previous one, it would, I think, be inadvisable to continue operations on these lines in Mian Mir during a third year.

During the present year, however, it is extremely important for the operations against mosquitoes to be carried on with great vigour, because although it might not be possible to produce much effect during the first year of operations, yet continuous efforts carried out over a period of two years may produce a very different result.

I attribute great value to the other operations carried out, viz., the attempt to lessen the effects of obvious sources of infection of *anopheles* in cantonments, either by the removal of infected children from the vicinity of barracks or by their treatment with quinine.

The latter is a measure which requires no special knowledge, and one which is applicable to every place where large numbers of native children are gathered together in the vicinity of European troops. One of the features of the year was the marked freedom from attacks of malaria of the adult Syces in the Royal Artillery lines. No statistics are available regarding these men, but the fact was apparent to all the officers of the Royal Artillery, and the contrast between the health of adult native servants in these lines and in the British Infantry lines was very marked. During 1901 all the adult Syces received a prophylactic dose of 10 grains of quinine twice a week, but I am informed that, in spite of this, great difficulty was frequently experienced in getting the work done on account of the large number of Syces constantly away with fever. During 1902, however, *although none of the adult Syces received prophylactic doses of quinine*, scarcely a single case of fever occurred among them throughout the year. I attribute this almost entirely to the treatment of the children (who are undoubtedly the chief source of infection of *anopheles*) with quinine, and in the case of the first series of Syce lines to their removal from the range of *anopheles*.



Temperature charts of fever cases usually returned in military hospitals as "ague," but in which repeated examinations failed to show the presence of malaria parasites, and which recovered without any quinine treatment (p. 32).

APPENDIX B.

A Rough Statement of the Expenses incurred for the Anti-Malarial Operations at Mian Mir (to October 31, 1902).

No.	Item.	Cost.		
		R	a.	p.
1	Wages of coolies at 4 annas each per day	711	0	0
2	Filling pools. Work done by contractors (202,601 cubic feet)	596	4	2
3	Emptying pools and drains. Work done by contractors	194	12	0
4	Brick-lining and plastering watercourse. Total length, 4985 feet	5364	14	6
5	Contingent expenses for kerosine oil, materials, etc., about	350	0	0
	Rupees	7216	14	8

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